PHYTOGEN

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NEWSLETTER
FOR
AUSTRALIAN
PLANT SCIENTISTS

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ASPS Newsletter Editor

helen.irving@vcp.monash.edu.au **Helen Irving** **Monash University**

A big thanks to all the scientists who contributed to this issue of Phytogen.

Editor's corner

Dear Fellow Society Members,

Thank you for all of your contributions, as we again have another excellent issue of Phytogen. The "state of affairs" focussing on New South Wales highlights some of the research occurring in plant sciences in NSW (see page 9).

This year ASPS turns 50. For a foretaste of some details of planned events to celebrate this momentous occasion see page 8.

Please keep the articles coming as it is your contributions that make Phytogen a success. A two year roster is in place for the "State of Affairs" and **South Australia** will feature in the next issue. Reports from local, national and international meetings relevant to plant science are welcomed; so please send reports to the editor (phytogen@asps.org.au) for publication in "From our Seed Banks".

I think that this is an appropriate time to announce that I will not be continuing in my role as editor of Phytogen in 2009. I have enjoyed my role as editor since 2004 and particularly the help and assistance that I have obtained from the Executive and Discipline representatives in that period. I thank all members for the opportunity to make e-contact with many of you and actually meet at meetings such as ComBio. However, it is time for some one else to take over the role.

Helen Irving

URGENT CALL for Reports on Meetings

We are always on the look out for reports on the conferences that our members attend. This is an opportunity to write about research that excites you and share your interests with our members.

Please send meeting reports to: reports to the Phytogen editors (phytogen@asps.org.au)

DISCIPLINE AND STATE PERSPECTIVES

Plant Accelerator – Adelaide Node

On Monday July 28, the Premier of South Australia attended a ceremony to launch the beginning of construction of The Plant Accelerator at the Waite Campus of The University of Adelaide. The Accelerator forms one of the two nodes of the Australian Plant Phenomics Facility. CSIRO Plant Industry Canberra laboratories will host the High Resolution Plant Phenomics Centre.

Professor Mark Tester, Director of the Australian Plant Phenomics Facility, said that he hoped 'the Australian Plant Phenomics Facility will help Australian plant science become even better at the pure, strategic and applied levels at a time when plant science is needed more than it has ever been needed.'

A bird's eye view of the Plant Accelerator

The Plant Accelerator will be a world-leading plant growth and analysis facility based at the Waite Campus of the University of Adelaide. It will accelerate pure and applied plant science research Australia-wide and internationally. The high technology glasshouse, with over 1km of conveyor systems and state-of-the art imaging, robotic and computing equipment, will allow continuous measurements of the physical attributes (phenotype) of plants automatically and non-destructively. The facility will accommodate 160,000 plants a year in programs such as those aimed at increasing drought and salinity tolerance in wheat and barley. Research on other economically important crops such as grapevines will also be accommodated. The Plant Accelerator will serve as the national headquarters of the Australian Plant Phenomics Facility. The APPF will have two nodes, one in Adelaide and the other in Canberra. Funding has been provided for The Plant Accelerator by the Commonwealth, as part of the National Collaborative Research Infrastructure Strategy (NCRIS), the South Australian State Government and the University of Adelaide.

Building will commence in early November, 2008 and the Accelerator will be fully operational one year later.

Contributed by Chris Ford
ASPS representative
resident in South Australia

EcoFizz – Post grad students

What: 7th One-day Postgrad Course on Ecology and Evolution
Date and time: 9am-5pm, 30 November, 2008
Venue: Eastern Avenue Auditorium and seminar rooms, University of Sydney, NSW
Note: Early bird registration to the ESA Annual Conference closes 30 September
Detail: The day's program will include speakers about recent advances in many areas of ecology and evolution and about the nexus between science and politics. There will be focus groups for students to exchange views. The schedule has links to web pages for the staff contributing.

For schedule of the day: http://www.bio.mq.edu.au/ecology/schedule2008.htm
For more information: http://www.bio.mq.edu.au/ecology/esa2008.html
To register: http://www.ecolsoc.org.au/2008SydneyConference.htm

A message about EcoFizz 2009

At EcoFizz07 last year in Richmond there was some discussion (and a few promises by me) regarding the idea of incorporating a dedicated plant ecophysiology theme into ComBio09 which is due to be held in Christhcurch next year. This message is a brief confirmation that this is taking place so you can plan to visit us in NZ late next year.

I am attaching a poster outlining the breadth of the conference (see page 31) – this shows that, in addition to the usual Plant Biology theme, Margaret Barbour and Owen Atkin will be heading a theme entitled "Plant Ecophysiology and Global Change Biology". Details of the actual symposium topics will surface in the coming months. I am certain that the breadth of topics will keep even the most battled hardened EcoFizzer happy and allow our young members to get a good range of topics in plant biology as well.

We are looking forward to seeing you seeing you in Christchurch next year!

Regards
Matthew Turnbull
ComBio 2009 organising committee


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COMBIO 2008

Plant Sciences in Canberra, September 2008: COMBIO and much, much more

There will be two major conferences for plant scientists September 18th to 25th in Canberra with over 20 international speakers and 60-70 national speakers. It will also be the 50th anniversary of our society, The Australian Society of Plant Scientists. So make your plans now to come to Canberra.

COMBIO Satellite and Boden Conference on Plant Energy and Water Productivity: from genes to environment, September 18-20th

- 18 International and 18 National speakers covering hormone signalling, transpiration, photosynthesis, drought and oxidative stress signalling, organelle biogenesis and metabolism, artificial photosynthesis, biofuels, genomics and global climate change.
- The aim of the symposium is to bring together scientists to assess the future strategies necessary to develop improved plants for agriculture and bio-fuel production and to assess plants in natural environments.
- We thank our sponsors, including ARC Centre of Excellence in Plant Energy Biology, CSIRO, Australian Academy of Science, COMBIO and ASPS.

COMBIO, September 21-25th.

ComBio2008
National Convention Centre Canberra
21-25 September 2008

- A dedicated Plant Sciences Stream with over 50 speakers, plus, symposia on plant biology in the other cellular and biochemical streams.

- Plants from Genes to Geoscience. An extra plant stream for 1 day on ecophysiology and plant ecology sponsored by ARC Research Network for Vegetation Function (http://www.vegfunction.net/index.html)

- ASPS Celebration of 50 years. Make sure you attend this special and unique event in the history of our society. More details are provided in this issue of Phytogen or via Paul Kriedemann kriedemann@rsbs.anu.edu.au

- Early Career Scientists. This year we have increased the number of talks per symposia to enable 2 talks to be chosen from abstracts and preference will be given to early career scientists (PhDs and postdocs). We will also be running a Careers Development Workshop.

More information on the meetings are provided within this issue of Phytogen and on the Conference Websites: http://www.asbmb.org.au/combio2008/index.html and http://www.plantenergy.uwa.edu.au/webpages/conferences/index.html or www.csiro.au/events/CropBio2008-symp

See you in Canberra,

Barry Pogson (barry.pogson@anu.edu.au), Frank Gubler and Rudy Dolferus
On behalf of the COMBIO Organising Committee and the Plant Energy and Water Productivity Organising Committee.

ASPS 50th Anniversary

The Australian Society of Plant Physiologists was formed 50 years ago and the first Conference, held in August 1958 in Adelaide was attended by most of the Inaugural members.

We are celebrating this anniversary at the Annual ASPS Dinner held in conjunction with the ComBio08 Conference being held in Canberra at the end of September. The Dinner is on the evening of Tuesday September 23 at the CSIRO Black Mountain site. We have invited Original ASPP members to attend and have had 13 acceptances and regrets with best wishes from 7 others. During the Dinner celebrations there will be a slide show loop of photos of our early members from then and more recently organised by Paul Kriedemann and Martin Canny and a few short but obligatory speeches. We will also display paper sheets with the original members names and encourage Conference and Dinner participants who have had a scientific relationship with these members, or their Scientific Descendents, to write their names on the appropriate members sheet. We hope some of this may be published on the ASPS website or in Phytogen.

Tony Ashton
Hon Treasurer ASPS

State of Affairs

Focusing on one state's research per edition

This edition:

New South Wales

The following feature highlights some of the current plant science related research activities in New South Wales. It was compiled from contributions by those ASPS members, who responded to the call, and therefore only covers selected activities and workgroups.

Plant Research news from The University of Sydney

Plant Ecophysiology Research at The University of Sydney

Contributed by Charlie Warren: charles.warren@bio.usyd.edu.au

The Plant Ecophysiology group at The University of Sydney is two years old and expanding rapidly. We have a range of - and field-based projects examining various aspects of plant and ecosystem function. Current major projects include:

How do plants cope with temporal variability in water and nutrients?

We have an ARC Discovery project to investigate the ecology and physiology of temporal variation in water and nutrient supply. The fundamental premise of this work is that plants must tolerate long periods of low water and nutrient availability and also respond to brief periods of high water and nutrient availability. This is best illustrated by rainfall in arid and semi-arid ecosystems, which is characterised by long rain-free periods that are interrupted by short periods of rainfall. Temporal variability in water and nutrient availability is the "norm" in many ecosystems, yet the ecology and physiology of plants under temporally variable regimes has received much less attention than steady-state conditions. A combination of field and glasshouse studies is examining responses of plants to pulses of nutrients (e.g. following snowmelt, or after rain). Experiments on temporal variability in water are focussing on factors that limit recovery of plants from drought.

Measuring soil respiration in the NSW High Country (Photo: M. Taranto)

Limitation of photosynthesis by the internal resistance to CO_2 movement

Our group recently received an ARC-LIEF grant to purchase a tuneable diode laser for measuring isotopes of CO_2. This instrument will be used to complement on-going experiments examining the internal resistance to CO_2 movement. Internal resistance describes the movement of CO_2 from the sub-stomatal cavities to site of carboxylation. This involves the diffusion of CO_2 across cell walls, plasma membrane, cytosol and chloroplast envelope before finally reaching the sites of carboxylation. Many studies over the past two decades have shown that internal resistance is large and imposes a limitation on photosynthesis only slightly smaller than that due to stomatal resistance. What we are currently interested in is how and why internal resistance is affected by different environmental variables (e.g. light, [CO_2], nutrient supply, humidity, drought).

Do plants get "hangovers"? Recovery of photosynthesis from high (sub-lethal) temperatures

Chlorophyll fluorescence suggests all species can withstand temperatures of 45-50°C. This very high temperature tolerance does not seem to vary among species from different habitats (i.e. little evidence of adaptation). At any rate, the ecological relevance of such high temperatures is questionable given that it is rarely if ever that hot. What might be more relevant is how and why photosynthesis is reduced following exposure to high, sub-lethal temperatures (e.g. 40-45°C). In other words, do high temperatures cause plants to suffer from a "hangover"?

Uptake of organic nitrogen by Australian native plants

A central assumption of ecosystem N cycling has been that organic nitrogen (N) must be converted to inorganic N (ammonium and nitrate) to be available for plant uptake, and thus N mineralization has been viewed as the bottleneck in plant N nutrition. More recent studies indicate a variety of plants can directly take up significant quantities of organic N, especially simple forms such as amino acids and thus bypass the bottleneck of N mineralization. Organic N is an extremely heterogeneous grouping that contains everything from amino acids to soluble proteins. 95% of studies have examined uptake of only one amino acid (usually glycine because it is cheap). This is problematic given that amino acids are a small proportion (1-10%) of organic N. Hence, our ability to generalize about uptake of organic N (*sensu stricto*) is rather limited. We are redressing this problem by investigating uptake of a range of different forms of organic N. Our group is developing a range of isotope labelling and biomarker approaches to trace fluxes through plants, fungi and bacteria.

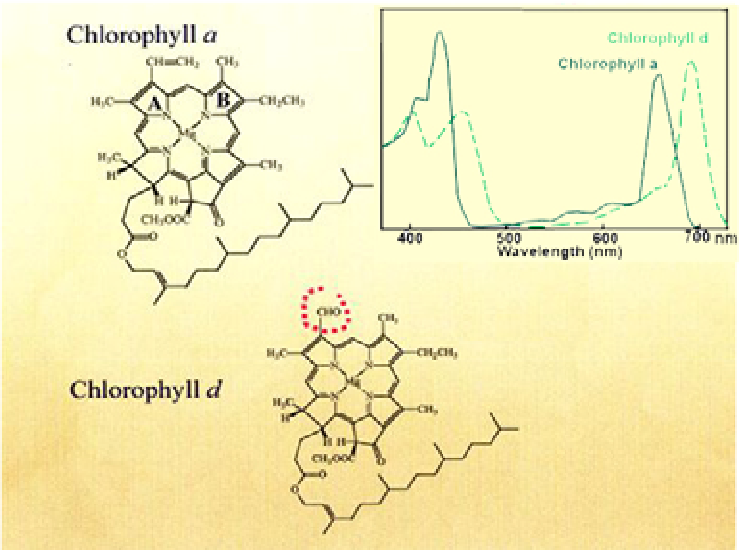
Novel Chlorophyll and new direction in photosynthesis

Contributed by Dr Min Chen, School of Biological Sciences, University of Sydney

To increase the efficiency of photosynthesis, Nature has evolved varieties of chlorophyll that encompass most of the range of visible light, enabling the maximal use of sunlight. Until recently, all oxygenic photosynthetic organisms (cyanobacteria, algae and plants) had been found to contain chlorophyll *a* as their major photopigment. However, *Acaryochloris marina*, a novel cyanobacterium (Blue-green alga) that contains mainly Chl *d* (> 95%), was discovered in 1996 and challenged the previous view of oxygenic photosynthesis.

The only difference in structure between Chl *a* and Chl *d* is at the C-3 position of the tetrapyrrole, where the vinyl group in Chl *a* is replaced by a formyl group in Chl *d*. This change results into the unique optical properties of Chl *d*: its absorption peak lies at 690–720nm, where other chlorophylls cannot absorb (Fig 1); Chl *d* is the only Chl found that can replace all of the roles of Chl *a* in oxygenic photosynthesis.

The research group in the School of Biological Sciences led by Dr Chen (QEII fellow) has made significant progresses toward understanding the molecular and biochemical mechanism of the photosynthesis using chlorophyll *d*.



Chemical structure and Spectra of Chl a and Chl d

Occurrence of novel Chlorophylls and their ecological implication

Chl *d* allows the cyanobacterium *Acaryochloris marina* the critical advantage of using longer wavelengths of light (690–750 nm) that are not absorbed by organisms containing other Chls. We revealed the ecological niche of *Acaryochloris* and predicted the likelihood that organisms containing-Chl *d* occur throughout environments in which infrared light is predominant, and may play a key role in oceanic food chains. We are exploring this at both the ecological and molecular levels. Recently, we have collected 4 strains of Chl *d*-containing organisms and are doing the physiological and genomic comparison. This work is an active collaboration with scientists from USA, Germany and Denmark.

Biosynthesis of novel photopigments

Chl *d* is unusual in both having an absorption band in the near-infrared region of the spectrum, and being the only molecule other than Chl *a* that can provide sufficient energy to drive the water-splitting reaction. Understanding the molecular mechanisms of the biosynthesis of Chl *d* will have a significant bearing on attempts to improve the competitiveness of solar energy, by enhancing knowledge of the development of Nature's 'solar power station'. We are working on discovering how Chl *d* is synthesized, in particular, the later stages in the biosynthetic pathway, where the specific side chains of various chlorophylls (Chl *a*, Chl *b*, Chl *d* and Chl *a2/b2* etc) are formed. Recently, the complete genomic sequence of a Chl-*d*-containing cyanobacterium, *Acaryochloris marina* was determined and guides the direction of this study. To this end, we are doing genomic hybridization, PCR and bioinformatic analyses comparing the known genome of various cyanobacteria to streamline down the candidate genes in the path to Chl *d* biosynthesis. We are also doing the biochemical and molecular analysis to explore the function of possible biosynthesis reactions and enzymes.

Evolution of photosynthesis

The optical properties of Chl *d* fill in the absorption gap between Chls (Chl *a* and *b*) and Bchls; this suggests that Chl *d* may have been a critical intermediate stage between oxygenic photosynthesis (using Chls) and anoxygenic photosynthesis (using Bchls), although we are uncertain yet whether it is an evolutionary intermediate stage or a recent adaption to a particular environment.

ARC Centre of Excellence in Plant Energy Biology: Sydney node

Contributed by Penny Smith and David Day

Research in the Sydney node of Plant Energy Biology based in School of Biological Sciences at University of Sydney focuses on the role of mitochondria in the plant's response to oxidative stress and the nature and function of by-pass enzymes in the plant respiratory chain (the alternative oxidative [AOX] and type 2 NAD(P)H dehydrogenases [ND]). In Arabidopsis, the AOX gene family is comprised of five genes and the ND enzyme family is composed of two sub-families, internal and external NDs. **Michelle Barthet**, **Renee Simms**, **Ozlem Yilmaz**, **Penny Smith** and **David Day** are charactering T-DNA insertion and RNAi lines for many of these genes. Of particular interest is the role of the alternative respiratory pathway in plant stress responses. As the products of some of these genes are dual targeted to chloroplasts and mitochondria or peroxisomes and mitochondria (Carrie et al., 2008) our analyses will include location specific complementation to determine the role of the proteins in each organelle.

Angela Ho, **Penny Smith** and **David Day** are collaborating with **David Guest** to investigate the role of mitochondria and the alternative respiratory pathway in initiation of programmed cell death (PCD) (the hypersensitive response) during pathogen attack. Arabidopsis Col-0 are susceptible to infection by *Phytophthora palmivora* RAT isolate (Daniel and Guest, 2006) but when they are grown in phosphonate the seedlings exhibit a biochemical response to the pathogen that is similar to an incompatible reaction. Cells surrounding the infection site undergo a hypersensitive response, a form of PCD and so we can use this interaction in our study. The project will study the molecular differences between compatible and "incompatible" interactions and will utilize mutants for components of the alternative respiratory pathway to study its role in PCD. We will also characterize signal molecules that move between cells to initiate PCD in cells that have not had contact with the pathogen.

Carrie C, Murcha MW, Kuehn K, Duncan O, Barthet M, Smith PM, Eubel H, Meyer E, Day DA, Millar H, Whelan J. (2008) Type II NAD(P)H dehydrogenases are targeted to mitochondria and chloroplasts or peroxisomes in Arabidopsis thaliana. FEBS Letters 582:3073-3079.

Daniel, R. and Guest, D. I. (2006). Defence responses induced by potassium phosphonate in *Phytophthora palmivora*-challenged *Arabidopsis thaliana*. Physiol. Mol. Plant Pathol. **67,** 194-201.

Identification and Characterisation of Transporters from the soybean symbiosome membrane

Legumes are essentially unique in their ability to form an endo-symbiosis with nitrogen-fixing bacteria collectively known as rhizobia. In this symbiosis the rhizobia are obligate symbionts called bacteroids and are located in organelle-like structures called symbiosomes within root nodules. These symbiosomes consist of one or more bacteroids enclosed in a plant-derived membrane called the symbiosome membrane (SM). The SM serves a unique role in the plant, regulating the delicate balance between the two symbionts, which requires a unique complement of carriers and associated enzymes. To date only a handful of SM-associated proteins have been molecularly characterised, including a number of secondary active transporters involved in sulphate, zinc and iron transport. **Patrick Loughlin, Andrew Ritchie, Penny Smith** and **David Day** from the School of Biological Sciences at Sydney University are identifying proteins responsible for catalysing transport of reduced carbon and iron across the SM. Biochemical and genetic evidence suggest dicarboxylates such as malate are the major transported carbon species across the SM. As such we have been studying putative soybean dicarboxylate transporters from the SLC13 and PTR families and are examining their expression patterns and localisation in nodules. Using GFP fusion proteins we are also studying the subcellular localisation of three nodule-expressed iron transporters to determine whether they are expressed on the soybean SM. In addition, we are investigating the localisation patterns of GFP fused to various truncated forms of the symbiosome membrane zinc transporter, GmZIP1, in an attempt to elucidate the mechanism(s) for trafficking of proteins to the symbiosome membrane.

Long Distance Signalling in plants

Matthew Spencer and **Penny Smith** are working at USYD on a collaborative project with Caren Rodriguez and Craig Atkins at UWA to study signals translocated in phloem. Much of the work focuses on translocation of miRNAs. We are developing genetic and biochemical assays to identify the proteins that mediate translocation of miR399 in response to phosphorus deprivation and also using micrografting to assess whether other miRNAs are translocated. We are also studying the mRNA and protein components of phloem.

Allergenic Proteins in Lupin Seeds.

As lupin has been used more as a food from humans it has become clear that some of the seeds proteins are allergenic. Some people are allergic only to lupin while others seem to react to lupin and other legumes. This may indicate that allergic proteins from different legumes share cross-reactive epitopes. **Penny Smith** and **Gisela Mir** have been working with collaborators at Royal Alfred Hospital, Royal Adelaide Hospital and Princess Margaret Hospital Perth to characterise the allergenic proteins of lupin and investigate cross-reactivity between lupin allergens and those of other legumes, particularly peanut. A study where peanut allergic individuals were challenged with food containing lupin flour showed that only a small proportion of peanut allergic individuals are also allergic to lupin and that these individuals react to different lupin proteins to individuals that react only to lupin.

Grapevine and Wine Research at Charles Sturt University

from Dennis Greer, Chalres Sturt University

The National Wine and Grape Industry Centre, one of several Research Centres at Charles Sturt University in Wagga Wagga, NSW, is a partnership between the School of Agriculture and Wine Sciences, the viticulture section of the NSW Department of Primary Industry and the NSW Wine Industry Association. In 2006, the Centre was awarded some $14 M over 5 years in a Winegrowing Futures project by the Grape and Wine Research and Development Corporation. This grant has enabled some 9 post docs and 7 technical officers to be appointed to the Centre.

The vine physiology theme, lead currently by Dennis Greer, is addressing some basic aspects of grapevine performance both in vineyards and using controlled environments. One research project is addressing the question of heat events impacting on sugar accumulation in grape berries. Over the past two growing seasons, canopy temperatures have been monitored with infra red radiometers and using 70% overhead shade cloth to ameliorate the canopy microclimate. The only problem, despite the evidence that the climate is changing, was that the 2006/07 and 2007/08 growing seasons were virtually devoid of heat events, at least those above 40^{o}C. This contrasts with some 50% of the days of January 2006 exceeding 40^{o}C in the Riverina. However, despite the lack of heat in our studies, with our small lot experimental winery, wine has been made from the grapes and sensory assessment will be undertaken shortly. And the shade does reduce temperatures but also the yield.

Thank goodness, the funding allowed the purchase of several controlled environment chambers, and using potted vines we have been able to assess 2- and 4-day 40^{o}C heat events on grapevines and bunches at different stages of development. Leaf photosynthesis gets a shock but appears to recover, berries fall off or shrivel and we are still assessing what impacts there are on shoot growth and development, in terms of leaf appearance patterns, leaf expansion and stem growth and we are also waiting to see what happens to sugar import into the berries. The heat stress team also comprises Dr Marc Thomas as Post Doc and Chris Weston as technical officer.

Other research projects include nutrition and carbohydrate reserves lead by Dr Bruno Holzapfel and vascular transport studies lead by Dr Suzy Rogiers.

Shade cloth mark 2 placed over grapevines ready for the 2008/09 growing season

Semillon vines in controlled environment chamber waiting their fate to be exposed to 40^{o}C

Photos C Weston

Plant Research @ *The* University *of* Newcastle

Discipline of Biological Sciences
School of Environmental & Life Sciences

ARC CENTRE OF EXCELLENCE FOR
INTEGRATIVE LEGUME RESEARCH

Research in the Centre focuses on plant development and plant biotechnology and provides insights into mechanisms of meristem and organ differentiation and intercellular communication utilising comparative genomics in the internationally recognised model legumes for genomics and genetics *Lotus japonicus* and *Medicago truncatula*. Studies also focus on two major crop legumes – soybean and pea, and also Pongamia used for biodiesel production.

Research at The University of Newcastle Node – Ray Rose laboratory

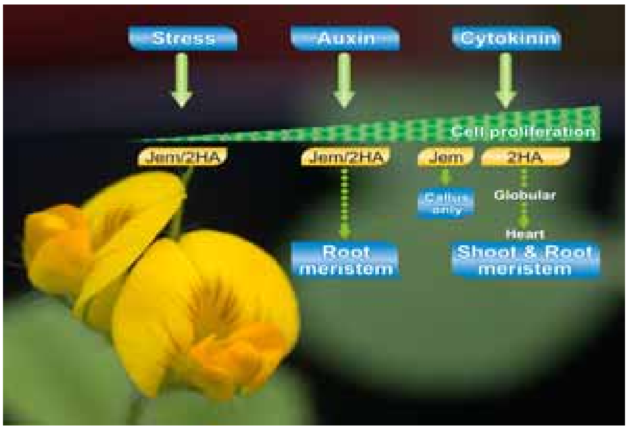
(Professor Ray Rose, Dr Kim Nolan, Dr Sergey Kurdyukov, Dr Michael Sheahan, Dr Xin-Ding Wang, Shih Chen, Feki Mantiri)

Research is centred on *Medicago truncatula*, a genetic and genomic model for the nitrogen-fixing legumes, which is used to study interaction with other organisms, plant development and stress biology. Non-legume models such as Arabidopsis are used as required.

Rose, R.J. (2008) *Medicago truncatula* as a model for understanding plant interactions with other organisms, plant development and stress biology: past, present and future. *Functional Plant Biology* 35, 253-264

Signalling in the induction of somatic embryogenesis in *Medicago truncatula*

Medicago truncatula (genotype 2HA) can produce somatic embryos (SEs) when leaf explants are cultured on a basal nutrient medium containing the plant hormones auxin and cytokinin. We are investigating the key signalling steps in the induction and development of somatic embryos, centred on the following. The first signals perceived by the explant on excision are reactive oxygen species (ROS), which are essential for the first cell divisions. Secondly, the stress hormone ethylene is synthesised. The auxin and cytokinin in the culture medium, together with the newly synthesized ethylene, have specific roles in SE induction. SEs derive from two types of stem cell – firstly, vein procambial cells and secondly, stem cells derived from dedifferentiated mesophyll cells. These stem cells become committed "embryo" stem cells, in part due to the action of the WUSCHEL transcription factor, whose expression is cytokinin-



dependent. Transcription of the *SERK1* (Somatic Embryo Receptor Kinase1) gene follows and marks cells that will differentiate into SEs. Ethylene, auxin and cytokinin are necessary for the induction of the transcription factor MtSERF1 (Somatic Embryo Related Factor1) which signals embryo development after about two weeks in culture. In addition to gaining insight into developmental mechanisms, understanding somatic embryogenesis will assist transformation of all legumes and contribute to understanding apomixis which would allow the genetic capture of "hybrid vigour". Novel stress-related genes are involved in somatic embryogenesis. Selected publications:

Imin, N., Nizamidin, M., Daniher,D., Nolan, K.E., Rose, R.J., and Rolfe, B.G. (2005) Proteomic analysis of somatic embryogenesis in *Medicago truncatula*. Explant cultures grown under 6-benzylaminopurine and 1-naphthaleneacetic acid treatments. *Plant Physiology* 137, 1250-1260.

Nolan, K.E., Saeed, N.A. and Rose, R.J. (2006) The stress kinase gene *MtSK1* in *Medicago truncatula* cv. Jemalong with particular reference to somatic embryogenesis. *Plant Cell Reports* 25, 711-722.

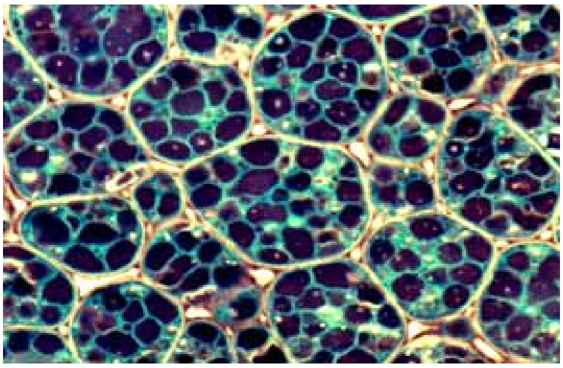
Rose, R.J. and Nolan, K.E. (2006) Genetic regulation of somatic embryogenesis with particular reference to *Arabidopsis thaliana* and *Medicago truncatula*. *In Vitro Cellular and Developmental Biology – Plant* 42, 473-481.

Mantiri FR, Kurdyukov S, Lohar DP, Sharopova N, Saeed NA, Wang X.-D, VandenBosch KA & Rose RJ. (2008) The transcription factor MtSERF1 of the ERF subfamily identified by transcriptional profiling is required for somatic embryogenesis induced by auxin plus cytokinin in *Medicago truncatula*. *Plant Physiology* 46, 1622-1636.

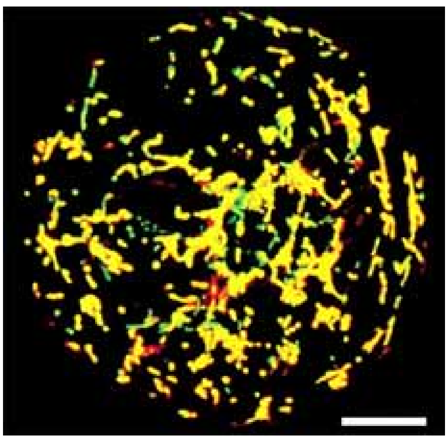
Mantiri F.R., Kurdyukov, S., Chen, S-K and Rose, R.J. (2008) The transcription factor MtSERF1 may function as a nexus between stress and development in somatic embryogenesis in *Medicago truncatula*. *Plant Signaling and Behaviour* 3, 498-500.

Transcriptional regulation of zygotic embryogenesis in *Medicago truncatula*

In order to build on our experience with somatic embryos we have initiated investigations into zygotic embryogenesis to further understand the transcriptional regulation of embryogenesis. Ovules from flowers and developing pods have been isolated and embryos at different stages of ovule development characterised morphologically into different stages. Transcriptional profiling using microarrays and transcription factors from *M. truncatula* EST and TC databases are starting to identify transcription waves that may be linked to these developmental stages. We will seek to link transcriptional regulation of embryo development to the synthesis and accumulation of protein and oil (oil accumulating cotyledon cells can be seen in photograph).



When plants regenerate, individual plant cells must first dedifferentiate and then re-initiate cell division. Single mesophyll protoplasts can be readily isolated from leaves and the process by which a mature differentiated cell re-enters division can therefore be studied. The large leaf cells of tobacco (*Nicotiana tabacum*) and their robust protoplasts provide excellent material for using reporter genes and confocal microscopy to study organelle dynamics. The tobacco work is then integrated with genomic and mutant data in the model plants *Medicago truncatula* and Arabidopsis. During the transition from differentiated to dividing cell, we have found that distinct and discrete cellular processes exist to ensure faithful inheritance of organelles following cell division. As part of his ARC Postdoctoral Fellowship Project, Dr. Michael Sheahan is investigating the molecular mechanisms that underlie these organelle inheritance processes, and also, how organelle dynamics and functionality impinge on the transition from differentiated to dividing cell. An interesting finding is the massive mitochondrial fusion occurring during early protoplast culture (see figure at left). Such MMF enables the uniform



distribution of mitochondrial DNA throughout the mitochondrial population, thereby ensuring the continuity of the mitochondrial genome in new cells. This work has also identified novel components of the cytoskeleton required for effective plastid repositioning, and has revealed a novel role for peroxisomes in ROS signalling and in restoration of ROS homeostasis. Selected publications from this work:

Sheahan, M.B., McCurdy, D.W. and Rose, R.J. (2005) Mitochondria as a connected population: ensuring continuity of the mitochondrial genome during plant cell dedifferentiation through massive mitochondrial fusion. *The Plant Journal* 44, 744-755.

Sheahan MB, Rose RJ, and McCurdy DW (2006) Actin filament dependent remodelling of the vacuole during the dedifferentiation of mesophyll protoplasts. *Protoplasma* 230, 141-152.

Sheahan, M.B., Rose, R.J. and McCurdy D.W.(2007) Mechanisms of organelle inheritance in dividing plant cells. *Journal of Integrative Biology* 49, 1208-1218.

Rose, R.J., McCurdy, D.W. and Sheahan, M. B. (2007) Plant mitochondria In: Handbook of Plant Science Vol.1. (K. Roberts, Ed.) pp256-261. John Wiley & Sons. Ltd.

Plant Science Group

Research outputs of the *Plant Science Group* contribute to understanding key plant processes that underpin plant growth and development. Of paramount significance is our work on nutrient acquisition and transport combined with related developmental processes. These studies are strategically positioned to provide an information platform for biotechnological innovation aimed at optimising crop productivity in stressful environments. At the regional level this knowledge is being applied to mined-land rehabilitation and sustainable nutrient cycling in the management of ecosystems. Our Group has been strengthened by the arrival in early 2008 of Professor Christopher Grof and Associate Professor Yong-Ling Ruan, who add to the Group's expertise in nutrient transport and metabolism and provide new research directions in biofuels (Grof) and water use efficiency (Ruan).

Nutrient Transport and Metabolism in Developing Seeds and Fruits

(Professor Christopher Grof, A/Professor David McCurdy, A/Professor Yong-Ling Ruan, Emeritus Professor John Patrick, Conjoint Professor Tina Offler, Dr Stephen Dibley, Felicity Andriunas, Kathy Dibley and Hui-Ming Zhang)

The goal of this program is to understand the regulation of nutrient (amino acids, ions and sugar) transport in sinks (net importers of nutrients). Mechanisms regulating membrane transport are being discovered using developing seeds (grain legumes; cereals) and fruit (tomato) as experimental models. In these organs, there are mandatory membrane transport steps to and from the cell wall space during nutrient transit from the phloem (nutrient delivery tissue) to storage cells. For developing seeds, the program aims to identify inductive signals and processes regulating transfer cell development. These cells have invaginated walls (wall ingrowths) that amplify plasma membrane area to enhance transport of nutrients.

Transporters in developing seeds and fruits. Our research focuses on discovering membrane proteins responsible for transporting nutrients to and from the sink apoplasm, their physiological significance and how their transport activities are regulated. Most progress has been made with sugar uptake from the sink apoplasm. Sucrose (pea cotyledons) and hexose (tomato fruit) transporters have been cloned and functionally characterised as proton symporters. Forward and reverse genetics has demonstrated that these transporters play a central role in sugar uptake by developing cotyledons and fruits. The latter finding has exciting biotechnological implications for increasing tomato fruit sugar and hence soluble solid content. Sucrose has been shown to function as a signal integrating metabolism with membrane transport in developing pea cotyledons. Sucrose release from maternal seed tissues appears to be mediated by a combination of proton antiport and facilitated diffusion. Recently, and for the first time in plants, genes encoding sucrose facilitators were cloned from seed coats and functionally characterised by heterologous expression in yeast. A functional cloning system for sucrose effluxers has been developed. In collaboration with Prof. Steve Tyerman (Waite Institute) and Dr Wen-Hao Zhang (Beijing Agricultural University), a suite of ion channels have been identified and characterised. These channels function to support release of key cations and anions from seed coats and uptake by cotyledons. Selected publications from this work:

Zhou Y, Qu H, Dibley KE, Offler CE, Patrick JW (2007) A suite of sucrose transporters expressed in coats of developing legume seeds includes novel pH-independent facilitators. *Plant Journal* **49**, 750-764.

Zhang W-H, Patrick JW and Tyerman SD (2007) Actin filaments modulate hypoosmotic-responsive K+ efflux channels in specialised cells of developing bean seed coats. *Functional Plant Biology* **34**, 874-884.

Zhou Y, Setz N, Niemietz C, Qu H, Offler CE, Tyerman SD, Patrick JW (2007) Aquaporins and unloading of phloem-imported water iin coats of developing bean seeds. *Plant, Cell and Environment* **30**, 1566-1577.

Tegeder M, Tan Q, Crennan AK and Patrick JW (2007) Amino acid transporter expression and localisation studies in pea (*Pisum sativum*). *Functional Plant Biology* **34**, 1019-1028.

Metabolic regulators in developing seeds and fruits. Following uptake into sink cells, sucrose must be degraded by either invertase (INV) or sucrose synthases (Sus) for various metabolic, biosynthetic and storage processes. Sucrose hydrolysis by INV in the cell wall may also play a critical role in controlling apoplasmic phloem unloading and subsequent transport processes. Little is known as how the activities of these proteins are regulated from transcriptional to post-translational levels and how manipulation of these regulations will impact upon seed and fruit development. We have been focusing on these issues using developing seed (cotton, rice and *Arabidopsis*) and fruit (tomato) as models. Progress has been made in elucidating the role of Sus in seed development and the post-translational regulation of invertase in tomato fruit. Selected publications from this work:

Ruan Y-L, Llewellyn DJ, Liu Q, Xu SM, Wu LM, Wang L and Furbank RT (2008) Expression of sucrose synthase in the developing endosperm is essential for early seed development in cotton. *Functional Plant Biology* **35**, 382—393.

Xu FQ, Li XR and Ruan Y-L (2008) RNAi-mediated suppression of hexokinase gene OsHXK10 in rice leads to non-dehiscent anther and reduction of pollen germination. *Plant Science* (in press).

Hossein F, Scofield, G, Badger MR, Chow WS, Furbank RT and Ruan Y-L (2008) Localization of sucrose synthase in developing seed and siliques of *Arabidopsis thaliana* reveals diverse roles for SUS during development. *Journal of Experimental Botany* (in press).

Transfer cell development. We are continuing our program exploring the regulation of transfer cell development. Platforms for our research are our novel experimental system for manipulating transfer cell induction in Faba bean cotyledons and Scanning EM techniques to image the 3-dimensional structure of wall ingrowths. We have established that reticulate wall ingrowths of Faba bean cotyledon transfer cells initiate as papillate projections before branching and fusing into fenestrated layers of wall material, and that the plasma membrane adjacent to these wall ingrowths is enriched in sucrose transport-associated proteins. Evidence to date suggests that, intriguingly, reticulate wall ingrowth architecture is independent of the microtubule cytoskeleton, but that cellulose deposition, possibly involving compromised rosette complexes, is essential to establish initial papillate wall projections. We are using cDNA-AFLP to investigate the inductive signalling cascades required to initiate wall ingrowth development and regulate the cellular machinery required to build the localized ingrowths themselves. In terms of inductive signalling, a gene discovery approach is being complimented by more targeted investigations of gene families known to participate in signalling pathways in plants. Thus far we have established that induction occurs very rapidly, within minutes, and that auxin and ethylene function as signals. Downstream signalling cascades include reactive oxygen species and calcium that collectively regulate polarity of, and foci for, wall ingrowth formation. Selected publications:

Wardini T, Talbot MJ, Offler CE, Patrick JW (2007) Role of sugars in regulating transfer cell development in cotyledons of Vicia faba seeds. *Protoplasma* **230**, 75-88.

Wardini T, Wang X-D, Offler CE, Patrick JW (2007) Induction of wall ingrowths of transfer cells occurs rapidly and depends upon gene expression in cotyledons of developing *Vicia faba* seeds. *Protoplasma* **231**, 15-23.

Talbot MJ, Wasteneys GO, Offler CE, McCurdy DW (2007) Cellulose synthesis is required for deposition of reticulate wall ingrowths in transfer cells. *Plant & Cell Physiology* **48,** 147-158.

Vaughn KC, Talbot MJ, Offler CE, McCurdy DW (2007) Wall ingrowths in epidermal transfer cells of *Vicia faba* cotyledons are modified primary walls marked by localized accumulations of arabinogalactan proteins. *Plant & Cell Physiology* **48,** 159-168.

Talbot MJ, Wasteneys GO, McCurdy DW, Offler CE (2007) Deposition patterns of cellulose microfibrils in flange wall ingrowths of transfer cells indicate clear parallels with those of secondary wall thickenings. *Functional Plant Biology* **34,** 307-313.

McCurdy DW, Patrick JW, Offler CE (2008) Wall ingrowth formation in transfer cells: novel examples of localized wall deposition in plant cells. *Current Opinion in Plant Biology* – in press.

Cotton fibre development and engineering

(A/Professor Yong-Ling Ruan; Em Professor John Patrick, Conj Professor Tina Offler)

Cotton is the major textile crop world-wide due to its cellulose-enriched fibres developed from the seed epidermis. Each cotton fibre is a single cell that elongates up to 3-6 cm in length and synthesises massive amounts of cellulose. This project aims to understand the molecular and cellular basis of rapid fibre cell expansion and cellulose synthesis with the final goal to improve fibre yield, quality and tolerance to drought by manipulating identified key genes and processes. Selected publications from this project:

Ruan Y-L (2007) Insights into the rapid cell expansion and cellulose synthesis mediated by plasmodesmata and sugar: Insights from the single-celled cotton fibre *Functional Plant Biology* **34**, 1-10.

Ruan Y-L, Llewellyn, D.J, Furbank, R.T. and Chourey, P.S. (2005) The delayed initiation and shortened elongation of fuzz-like short fibres in relation to altered patterns of SuS expression and plasmodesmata gating in a lintless mutant. *Journal of Experimental Botany* **56**, 977-984.

Ruan Y-L, Xu, S-M, White, and Furbank, R.T (2004) Genotypic and developmental evidence for the role of plasmodesmatal regulation in cotton fiber elongation mediated by callose turnover. *Plant Physiology* **136**, 4104-4113.

Ruan Y-L, Llewellyn, D.J, Furbank, R.T. (2003) Suppression of sucrose synthase gene expression represses cotton fiber cell initiation, elongation and seed development. *Plant Cell* **15**, 952-964.

Sorghum - A Biofuel Feedstock for Arid Environments

(Professor Christopher Grof)

Sorghum is an ideal crop for biofuel production from grain, sugar and biomass accumulation and is well placed to become the major bio-industrial cereal in northern Australia. A strong collaborative project established between the University of Newcastle, University of Queensland and Pacific Seeds is focused on producing sorghum hybrids for maximum ethanol production by the application of both precision breeding and TILLING approaches.

Restoration Ecology and Mined Land Rehabilitation

(Dr Carmen Castor, Mike Cole, Nigel Fisher, Lani Furner, Agnes Kovacs, Dr Yvonne Nussbaumer, Conjoint Professor Tina Offler, Emeritus Professor John Patrick, Samara Schulz).

A strong relationship has been established between the coal mining companies Xstrata Coal Mount Owen and Thiess Pty Ltd, and members of the Plant Science Group, at the Mount Owen Complex in the Hunter Valley to develop innovative strategies for ecosystem restoration and reconstruction on mined land and disused pastureland. This relationship led to the emergence of The University of Newcastle internal research centre, the *Centre for Sustainable Ecosystem Restoration*, and allowed the development of cross-group collaboration (Dr John Clulow & Associate Professor Michael Mahony, Environmental Biology and Biotechnology Group). The Model ecosystem restoration and reconstruction Site at Mt Owen that has evolved, the Ravensworth State Forest Vegetation Complex, was officially opened in February 2008.

The model site incorporates forest remnants, past and present biodiversity offset areas, and rehabilitation areas on mine spoil. This facility has an anticipated life of more than 20 years and the program being developed includes the study of the dynamics of the forest, reconstruction and restoration areas; longitudinal studies of spoil amelioration and the use of topsoil substitutes (funded by ACARP, that includes a verification site at Coal and Allied's Warkworth Mine); site preparation techniques for use in spoil and disused pastureland, including cost-benefit analysis; and the construction of vegetation sources to allow future modelling of forest and woodland composition in the different components of the vegetation complex. Research objectives include the provision of wildlife habitat, including the construction of habitat to maximize frog diversity, and support the endangered green and golden bell frog, should it return.

Our studies have shown that a critical problem in the Upper Hunter is a lack of natural nitrogen and phosphorus supply to support sustainable plant growth and life cycle completion. Early on, we found that, following extensive logging and grazing, the forest remnant only had up to 10% of the root-microbe associations that would be expected in an old growth forest, which this forest is not. These root-microbe associations are critical for sustainable nutrient acquisition, litter decomposition, nutrient cycling, pathogen resistance, soil aggregation and drought tolerance. Thus, a primary objective is to develop technologies for laboratory culture of these microbes and their return at levels that enable sustainable forest reconstruction. In our spoil amelioration experiment we now have up to 50% of the level of mycorrhizal associations expected in an old growth forest.

In addition, our research has been building models to measure success, and developing methods to determine the restoration potential of vegetation and its sustainability, including that of ecosystems under reconstruction. We are working towards identifying bottlenecks in plant species, sustainability, and the effects of future disturbances on the resilience of the new plant communities.

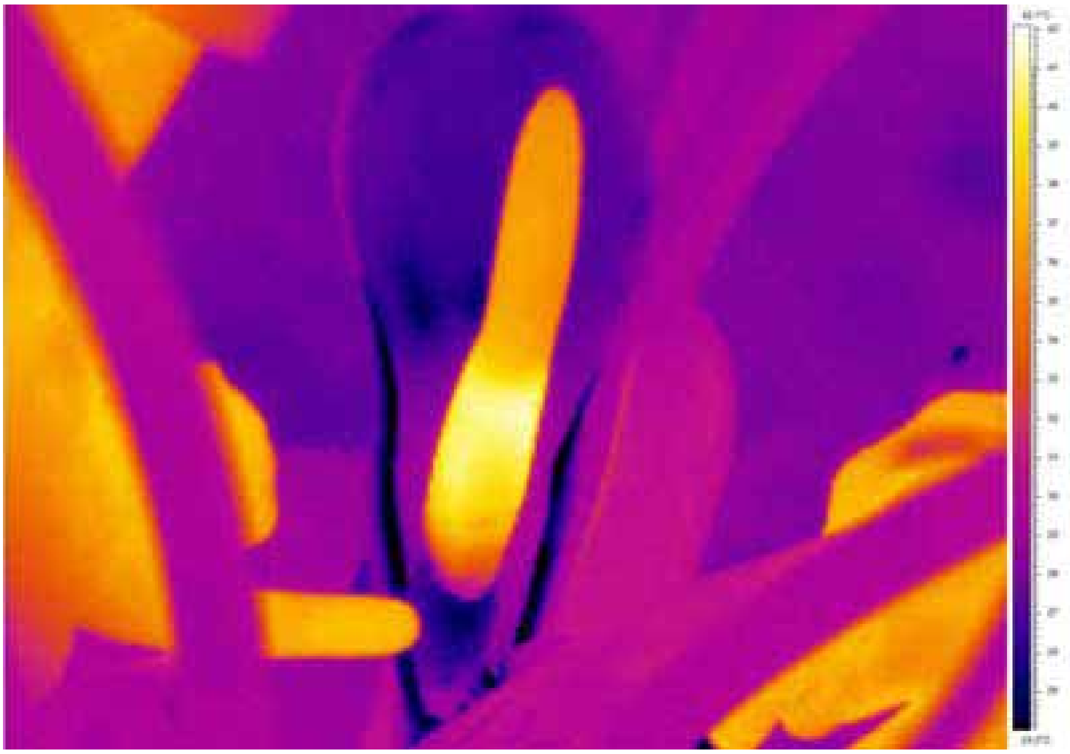
The Plant Science Group at Newcastle

How do thermogenic plants keep their flowers hot?

Contributed by Sharon Robinson University of Wollongong

Sharon Robinson, Nicole Grant, Rebecca Miller and Jennifer Watling.

The controlled generation of heat to maintain body temperature, homeothermy, is a trait usually associated with birds and mammals, however, the production of heat (thermogenesis) also occurs in some plants. Possible functions of thermogenesis in floral tissues are: to enhance the release of chemical compounds that attract pollinators, to provide a heat reward for pollinators, or to prevent low-temperature damage to floral tissues (Knutson 1974; Seymour 2001; Seymour *et al*. 2003). A diverse range of plants are thermogenic, and a small number of these are capable of thermoregulation, that is, sensing external temperature changes and generating heat at the cellular level to maintain tissue temperature within a narrow range. Examples of homeothermic plants include the Titan arum (*Amorphophallus titanum*) and the skunk cabbages (*Symplocarpus* spp.), well known for the putrid scents they produce to attract pollinators.



Thermal image of *Philodendron selloum* with the spathe cut away to show that whilst the fertile and sterile male florets heat the female florets do not.

Sharon Robinson (University of Wollongong), **Jennifer Watling** (University of Adelaide) and **Rebecca Miller** (Monash University) have been working on two homeothermic plants, the sacred lotus, *Nelumbo nucifera* (a eudicot) and *Philodendron selloum* (a monocot). Sacred lotus regulates the temperature of its floral chamber to 32-36 °C, across ambient temperatures of 8-40 °C, whilst Philodendron regulates between 32-36 °C, across ambient temperatures of 4-39 °C. The phenomenon of thermoregulation in these two unrelated plants provides an interesting example of convergent evolution, and a fascinating physiological problem. How do plants that lack the complex neural and hormonal systems found in birds and mammals regulate these floral ovens?

The energy for heating the flowers comes from uncoupled respiration in the plant mitochondria, either via the alternative oxidase or uncoupling proteins. Measuring how the stable isotopes of oxygen are fractionated during respiration shows which of these respiratory pathways are active during thermogenesis (Robinson *et al*. 1995). Unfortunately this method does not work when tissues are structurally dense, because diffusional limitations restrict the access of oxygen to the mitochondria and prevent the true fractionation occurring. Early attempts to measure fractionation in thermogenic plants were unsuccessful for this reason. Sacred lotus receptacles are very porous making them ideal for this method and recently we achieved the first measurements of *in vivo* fluxes through the alternative pathway in these thermogenic tissues (Watling *et al.* 2006). We are now confident that sacred lotus uses the alternative oxidase to produce all its heat (Watling *et al*. 2006 & 2008; Grant *et al*. 2008). In *Philodendron* the situation seems to be more complex and this plant may use both the alternative oxidase and uncoupling proteins to turbo charge its flowers to 42 °C. Our current research is focused on clarifying the situation in *Philodendron* and also understanding how the pathways are regulated to control the heating so precisely. In both plants, although alternative oxidase protein increases prior to thermogenesis, the fine regulation of its activity to achieve heating appears to be posttranslational.

References

Grant NM, Miller RE, Watling JR, Robinson SA (2008) Synchronicity of thermogenic activity, alternative pathway respiratory flux, AOX protein content and carbohydrates in receptacle tissues of sacred lotus during floral development. *Journal of Experimental Botany* **59:** 705-714

Knutson RM (1974) Heat production and temperature regulation in eastern skunk cabbage. *Science***:** 746-747

Robinson SA, Ribas-Carbo M, Yakir D, Giles L, Reuveni Y, Berry JA (1995) Beyond Sham And Cyanide - Opportunities For Studying The Alternative Oxidase In Plant Respiration Using Oxygen-Isotope Discrimination. *Australian Journal of Plant Physiology* **22:** 487-496

Seymour RS, White CR, Gibernau M (2003) Heat reward for insect pollinators. *Nature* **426:** 243–244

Seymour RS (2001) Biophysics and physiology of temperature regulation in thermogenic flowers. *Bioscience Reports* **21:** 223-236

Watling JR, Grant NM, Miller RE, Robinson SA (2008) Mechanisms of thermoregulation in plants. *Plant Signaling and Behavior* **3** 595-597

Watling JR, Robinson SA, Seymour R (2006) Contribution of the alternative pathway to respiration during thermogenesis in flowers of the sacred lotus, *Nelumbo nucifera*. *Plant Physiology* **140:** 1367-1373

Functional Plant Biology

Spring - 2008 Update

New Series: The Evolution of Plant Function

The Evolution of Plant Function – a virtual special issue for FPB

Starting mid-year in 2009, FPB will publish monthly reviews on a wide range of topics on plant function with an evolutionary theme. Next year marks the 200th anniversary of the birth of Charles Darwin and the 150th anniversary of his publication of The Origin of Species.

As the reviews are published, they will be collated as a virtual special issue, with a link on the home page of FPB. These papers will contain suitable background information to be a valuable resource for university students and young scientists, and as well present recent advances and cutting edge research in the area. At the end of the series they may be collated as a printed special issue.

Topics are wide-ranging and so far include the evolution of plant vacuoles, halophytes, C4 photosynthesis, mycorrhizas, plant viruses, apomixis, fertility in wheat, photosynthesis in algae, carbon isotope discrimination and water use efficiency, aluminium tolerance in grasses, phosphorus uptake mechanisms, symbiotic nitrogen fixation in legumes, flooding tolerance in higher plants, freezing tolerance in angiosperms, xylem vessel structure and function, flowering, and grain size in cereals.

Further contributions on this evolutionary theme are welcome, and can be discussed with the Editor-in-Chief (rana.munns@csiro.au).

Best Paper Award for young scientists

Functional Plant Biology and the Australian Society of Plant Scientists are pleased to announce the award of the best paper for 2007 from a young scientist to Abby Cuttriss. Abby will present her paper at ComBio2008 in September.

- Abby Cuttriss *et al*. Regulation of lutein biosynthesis and prolamellar body formation in *Arabidopsis*. *FPB* ***34***, 663-672 (2007)

A total of twelve nominations were received for this award. The decisions were made on the reports by the journal's reviewers and the ASPS executive council. All nominations were judged of high quality. Two were highly commended as being particularly novel and of biological significance:

- Yu Hua Wang *et al*. Plant natriuretic peptide active site determination and effects on cGMP and cell volume regulation. *FPB* ***34,*** 645-673 (2007).

- Mark Jackson *et al*. A bioinformatic approach to the identification of a conserved domain in a sugarcane legumain that directs GFP to the lytic vacuole. *FPB* ***34,*** 633-644 (2007).

I look forward to assessing the high quality papers from young scientists for 2008.

Rana Munns, Editor-in-Chief, Functional Plant Biology

Dr Rana Munns
Chief Research Scientist, CSIRO Plant Industry
Email: rana.munns@csiro.au
President-Elect, Australian Society of Plant Scientists

From Our Seed Banks

Meeting reports provided by members from around the country

We welcome meeting reports from all local and international meetings. Please contact the editor at phytogen@asps.org.au for further details.

We also welcome book reviews.

No contributions were forthcoming for this edition

IP Roots & Branches

EXHAUSTION OF PATENT RIGHTS

As a general principle the concept of patent exhaustion or "first sale" doctrine provides that once a patentee has sold a product covered by a patent, the patentee cannot use that same patent to prevent or restrict the purchaser from using or reselling the product. The patentee rights are said to be "exhausted". Similarly, patent exhaustion applies to the sale of a patented product by a licensee acting within the scope of its license. Accordingly, patent exhaustion occurs when a sale occurs by the patentee or any authorised third party.

In certain circumstances a patentee may try to limit or control patent exhaustion by endeavouring to impose limitations or conditions on any sale. In this manner, a patentee may try to restrict resale or the uses to which a product may be applied.

The validity of such limitations and the remedies via patent infringement (in contrast to breach of contract) has given rise to some uncertainty under Australian Law.

A recent decision in the US in Ovation Computer, Inc., v L.G. Electronics Inc. has held that an authorised sale of components that are later combined with other components to form a patented system and to practice patented methods results in exhaustion of all patents; including system and method patents, that are substantially embodied in those components. The US Supreme Court confirmed that the sale of components which substantially embody the essential or inventive features of the patent (method or process patents included) results in exhaustion of those patents. In deciding whether the components did substantially embody the patent, consideration was given to the fact that the only reasonable use for the components was to practice the patent in question.

Accordingly, it now appears that conditional sales are greatly weakened as a way of avoiding patent infringement, at least in the US.

In Australia, the laws in relation to these matters are not clear and embrace anti-competitive conduct, exhaustive dealings etc as understood by the Trade Practices Act.

In summary, whilst the doctrine of patent exhaustion provides some comfort to users of patented goods it is necessary to be wary of conditions of sale that may be associated with such products, notwithstanding the latest decision in the US.

Mark Wakeham
Patent and trade mark attorney
FB Rice & Co
mwakeham@fbrice.com.au

Did you know....?

- ***ASPS turns 50 in 2008.*** Many celebrations are planned. Several will centre around the annual meeting of ASPS at ComBio in Canberra in September 2008. For further details see page 8.

- ***ASPS Website.*** The ASPS website has been thoroughly revamped. Importantly membership dues can now be paid on line. We would like to remind you that if you wish to advertise jobs, PhD scholarships, conferences, books, etc. you can Caitlin Byrt via advertise@asps.org.au. To cover the costs involved, the society has introduced a small charge of $30 for members and $70 for non-members ***FOR EMPLOYMENT ADS ONLY***. Advertising conferences and books (edited by society members or containing chapters written by society members) are ***FREE OF CHARGE***.

- ***RN Robertson travelling fellowship.*** The named Fellowship recognises and celebrates the sustained contribution made by RN Robertson (Sir Bob) in nurturing young plant scientists in Australia spanning across four decades from the 1950's. The Australian Society of Plant Scientists is indebted to Hank Greenway and Joe Wiskisch who generated and championed the early development of the RN Roberston Travelling Fellowship.

- ***Student Travel Funds.*** Funds are set aside each year to sponsor student travel to our annual conference (next year in Canberra), and contribute to their professional development in plant science. Support will vary from year to year depending on the Society finances, location of meeting and number of applications. The Treasurer will apply a formula in calculating individual entitlements and takes these factors into account. Applicants must be financial members of ASPS and presenting a paper or poster at the ComBio meeting.

- ***Postgraduate Section.*** We are proud to announce that student members who have recently completed their PhD and had their thesis passed can submit a summary that features in Phytogen. The editors feel that this is an important opportunity for our postgraduate students to showcase their research. Such successful student members are advised that the summary can be accompanied by a key image in suitable format and that they should submit their items to the editors of Phytogen by the first of April, August or December to appear in the April (or May), September or December issues.

- ***Society funding for Workshops and Conferences.*** The society has a total of $10,000 available each year to provide seeding money and sponsorship for up to four conferences organised by members. The amount available to assist each conference will be about $2500. For more details see the website: http:/www.plantsci.org.au and take the link to conferences.

- ***Corresponding and Life memberships.*** Life Membership recognises an outstanding and sustained contribution to the Society by along standing ASPS member who, through their professional activities, has substantially enhanced the international profile of Australian plant science research. Corresponding Members are high profile overseas colleagues who have contributed substantially to plant science research within Australia. If you know of a deserving recipient for Life or Corresponding Membership, please consider putting a nomination forward. The procedure to follow is outlined on the ASPS website (see: http://www.plantsci.org.au/ and click on "About ASPS" where there is also a list of Life and Corresponding members).

UPCOMING CONFERENCES

UPCOMING CONFERENCES

ComBio2008

National Convention Centre, Canberra, Australia. 21 - 25 September, 2008

For details see page 7

First International Alternative Oxidase (AOX) and Stress Tolerance Symposium

www.aoxsymposium.uevora.pt

Evora, Alentejo, Portugal

23 October to 27 October

APGC Symposium: Plant Functioning in a Changing Global Environment

http://www.apgc.eu

University of Melbourne, Melbourne Sunday 7 to Thursday 11 December 2008

International Biogeography Society Fourth Biennial Meeting

http://biogeography.org

Merida, Mexico January 8-12 2009

Molecules of life: from discovery to biotechnology

http://www.ozbio2010.com/

Melbourne Convention Centre

26 September to 1 October 2010