PHYTOGEN

A
NEWSLETTER
FOR
AUSTRALIAN
PLANT SCIENTISTS

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In This Issue

Thanks to all the contributors for being prepared to give their time to provide informative articles for this issue of Phytogen

AUSTRALIAN SOCIETY OF PLANT SCIENTISTS

President's Annual Report 2011

Importance of plant sciences: As a rule, people are more fascinated by animals and human health than plants, making it challenging to attract students in large enough numbers to support large academic departments in the plant sciences. We only have to look at ancient cave paintings to realise that there is nothing new in focussing more on animals than plants. Nevertheless, the answers to supplying the food, fibre and fuel needs of 9 billion people without massive environmental degradation do lie, to a large extent, in plants. The recent article by Grierson et al. (New Phyt. 192:6-12, 2011) listing 100 important questions for the plant sciences demonstrates the limitations to our current knowledge, and identifies important areas for future research. We will only be able to address these with a concentrated research program, good funding, employing the brightest minds. The Global Plant Council has been created to help put plant research and education on the world stage. The American Society of Plant Biologists is holding a summit on plant research to develop strategic approaches. Next year the two main European plant societies (FESPB and the more agriculturally oriented EPSO) are holding a combined meeting with a view to presenting a united front. Within Australia we need to move plant science up the agenda. We need to continue to build links with like-minded societies. We do this each year at ComBio with the ASBMB and ANZSCDB, and with the New Zealand Plant Physiologists every 3 years. Next year in Adelaide the Plant Pathologists will join us as well. Now is the time for an active and healthy professional society

Conferences and prizes: Last year's OzBio2010 in Melbourne was a larger meeting, combined as it was with several international biochemical societies. Our own ASPS dinner was well attended and we thank the students from Monash who organised this. This year has been a big year already with the International Botanical Congress in Melbourne. Thank you especially to all the symposia and theme chairs, and Anna Koltunow particularly for all her work to make it a success. For the current ComBio2011, I want to thank Graham Bonnett and Susanne Schmidt for representing ASPS on the program committee and Jim Burnell for heading the organising committee. Congratulations also to all our prizewinners. The winner of the Goldacre award is Dr Chanyarat Paungfoo-Lonhienne (UQ), the ASPS Teaching Award is Dr Gonzalo Martín Estavillo (ANU) and the FPB Best Paper goes to Dr Helen Bramley (UWA). This year's JG Wood lecture is to be delivered by Prof Susanne von Caemmerer (ANU).

Communication is a core activity for the ASPS. Phytogen has had an excellent series of articles this year. I would like to thank Tina Offler for her work as editor and to all of you who contributed. I am pleased to announce that Tina has agreed to stay on for another year. One aim of my periodic President Updates is to increase the sense of community amongst plant scientists. We have a good number of student members, but once they graduate, and lose their institutional email accounts, it is hard to keep in touch. In order to better connect with the newest generation of plant scientists I have set up a FaceBook page (Australian Society of Plant Scientists) and a Twitter account (ASPS_Ozplants, #ozplants). Regular announcements are made using these platforms as it is much simpler than email. Members are able to post things on the ASPS FaceBook wall as well. I am hoping that this will promote networking amongst our younger members especially, as they move around the world.

Education. Good education is a fundamental first step in promoting plant science in Australia. Plants in Action 1 is now available through our website, free of charge. It has even been translated into Belarusian. A link to the Belarus translation is available on our FaceBook page. Plants in Action 2 is underway with Rana Munns as Editor. It was hoped to launch it this week but not enough chapters are complete (*mea culpa*). Susanne Schmidt has also been working very hard on this. For further details please contact Susanne or Rana.

Functional Plant Biology. We continue our special relationship with FPB. Rana Munns has been reappointed as Editor-in-Chief for a further two years (March 2011-March 2013). Submission and peer review work flows are now managed in ScholarOne Manuscripts. Professor Achim Walter, Dr Peter Solomon and Dr Lucas Cernusak have joined the Editorial Board in 2011. This year FPB has published a Special Issue (Actinorhizal Plants) and a Research Front (Root Systems for Dry Environments). We thank FPB/CSIRO Publishing for continuing to sponsor the Goldacre Award and Best Paper Award. We also thank Managing Editor Dr Chris Anderson for his support for the society this past year (e.g. allowing us to use the CSIRO Booth at IBC to distribute information about the Society). Updates to the PrometheusWiki can be found on FaceBook.

Council, Executive and Administrative changes

ASPS is a lean operation with no secretariat. Last year Jen Price (CSIRO) started working on a casual basis as an executive assistant to then President Rana Munns. Jen has decided to focus on her work with Plants in Action rather than on general ASPS admin. I want to thank Jen for her help during the past year, especially in getting the membership email reminders out and starting an update of our website and associated forms. It is my pleasure to welcome student member Rob Shepherd as executive assistant. Rob is now sending out the emails and handling the advertisements. The advertising opportunities offered through the society are appreciated by most of us. For the past three years Kiran Sarfaraz (CSIRO) has handled these. We thank Kiran for doing this with such efficiency and wish her well as she moves on to other things.

The executive consists of the President, Secretary, Treasurer, and the past President or President-elect (depending on the point in the cycle). We meet by phone approx. every month, and face to face a few a times a year. I want to thank the current executive for their efforts this year. It is with much sadness that we lose John Evans (Hon sec) and Rana Munns (past President) from their official roles on the executive. John and Rana have served the society in various capacities over many years. Their experience, together with that of past Treasurer Tony Ashton, has been extremely valuable to the new executive members. There is a real danger with a society such as ours that knowledge about the society can get lost with the turnover on the executive and the council. While much of the information is on the Website, you need to know where it is, and when things need to be done by. It is for this reason I am pleased to announce that Rob Shepherd will create a repository of knowledge, forms and a perpetual calendar that will persist beyond individuals. We are setting up a Google Calendar that will trigger emails to the generic president, treasurer etc. accounts on certain dates to make sure that notification of meetings, advertising of society awards and so on continue to be made in a timely manner.

Thank you also to Helen Irving for her work as Treasurer. I look forward to working with her for another year. Sponsoring students to travel to ComBio and providing seeding money or loans for conferences is important in meeting our brief of promoting plant science in Australia. Thank you to Helen, Rana and John who have been working out how we can be more consistent about the way we award these and the Robertson Awards and respond to requests to support conferences in Australia. It has become clear that we do need a bit more money to do this and I encourage you to support the modest increase in fees proposed by Helen Irving.

Finally, I would like to thank all the current, outgoing and incoming councillors for supporting ASPS and their readiness to help and and members of the supporting subcommittees, Barry Pogson (STA representative) and Marilyn Ball who has been our Public Officer for many year (the role relates to our registration as a legal entity in the ACT). Thank you to John Evans over from Marilyn.The council meets annually at ComBio. Earlier this year we had a phone-in meeting as well. I would like to see the

Council play a more prominent role in the society and to make the virtual meetings more regular. I will also be asking the discipline reps to contact the members in their area, and ask if people would be interested in acting as mentors or to be mentored. We are all busy, so it is important that this not be onerous. The simplest system would be for the mentor and mentee (assigned by the Rep) to meet once a year –probably at ComBio, or perhaps a specialist conference. The mentor could take the opportunity to introduce the younger member to other researchers and keynote speakers, and give them a few tips on how to get the most of the networking opportunities offered by conferences. Hopefully, this will be in place for 2012. Best wishes for the year ahead and happy researching.

Assoc/Prof Ros Gleadow, Cairns, September 2011

ASPS COUNCIL MEMBERS – 2012

Executive:		
President	Ros Gleadow	Monash University
President Elect	Tim Colmer	University of Western Australia
Honorary Secretary	Christine Beveridge	University of Queensland
Honorary Treasurer	Helen Irving	Monash University
Discipline Representatives:		
Genetics & Molecular Biology	Oliver Berkowitz	Murdoch University
Cell Biology	Zhonghua Chen	University of Western Sydney
Plant Microbe Interactions	Uli Mathesius	Australian National University
Whole Plants	Tim Cavagnaro	Monash University
Plant Development	Jim Reid	University of Tasmania
Environmental & Ecophysiology, Global Climate Change	Belinda Medlyn	Macquarie University
Plant Science Education	Kathleen Soole	Flinders University
Student Representative	Jessica Bovill	ACPFG, Adelaide
Public Officer	John Evans	Australian National University

ASPS SUB-COMMITTEES

FASTS Representative & Global plant Council	Barry Pogson	Australian National University
Phytogen Editor	Tina Offler	University of Newcastle
Functional plant biology Editor in Chief	Rana Munns	Functional plant Biology

SUPPORT SERVICES

Webmaster	Michael Major	Michael Major Media Pty Ltd, Adelaide

A message from the editor

Dear Fellow ASPS Members,

Happy New Year!!

A somewhat delayed 2011 issue of Phytogen. My apologies – December turned into a catastrophe for me and several others. Special apologies to those contributors who did have their act together and provided articles on time. The great thing for you is that you have started 2012 with a clean sheet and a clear conscience.

In spite of 'the editor' this issue is full of interesting articles – some pushing us back to review our Society's past, some acknowledging our recent successful Combio meeting and others pushing us forward as new research is presented and ongoing activities reported upon.

Under the '*Our Society – An Historical Perspective'* banner *Don Gaff* takes reminds us of the history of The Society' through his own experiences as a plant scientist in his article entitled *--"Great Interest in a Dry Topic"* (his ongoing research interest is 'resurrection plants'). Thanks Don for finding the time to write this account. '*Some Highlights from Combio2011'* include an article by Susanne von Caemmerer derived from her *JG Wood Lecture* **-** Enhancing photosynthesis to improve crop yield; *Symposium Reports* –Anne Rae & Yong-Ling Ruan, Michael Tausz & Fernanda Dreccer, Martha Ludwig the *Best paper Award* – Helen Bramley and **more……..** Thanks to all the contributors.

This issue also contains a large number of reports from our youngest members. Felicity Andriunas reports on her PhD research on signals that regulate transfer cell formation in *Vicia faba* cotyledons in '*From Our New PhDs'* and Lydia Guja, the 2010 recipient of a *'RN Robertson Travelling Fellowship'* provides us with insights of the research she is undertaking as do the three recipients of 2011 *'The Plant Nutrition Trust Awards'* - Sarah Noack**,** Chanyarat Paungfoo-Lonhienne and Natasha Teakle. Thank you to all these young scientists and good researching!! Finally, please note our ongoing activities through update reports on '*Functional Plant Biology*' and '*Plants in Action*' by Rana Munns.

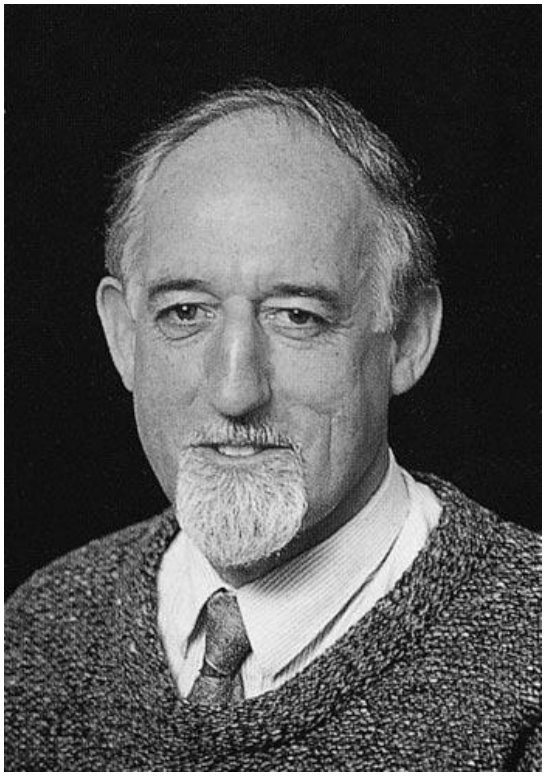
We've had a break from "*State of Affairs"* in this issue but the Queenslanders will rectify this in 2012 and we should also be hearing from the Western Australians. As always, any suggestions for articles, and of course contributions – book reviews, reports, significant issues for plant science, education issues, are most welcome.

I hope you all enjoy reading this issue.

Tina Offler

OUR SOCIETY AN HISTORICAL PERSPECTIVE

Donald F. Gaff
Currently:
Adjunct Researcher, School of Biological Sciences, Monash University



GREAT INTEREST IN A DRY TOPIC

After majoring in Botany and Zoology for a B.Sc. at the University of Melbourne (then the only University in Victoria), I began research there in 1957 in plant water relations for a M.Sc. under the supervision of Dr. Denis J. Carr, a man with wide botanical interests and a phenomenal memory for anything and everything he had read. Although at national botanical meetings he presented as strongly opinionated and contentious, as a supervisor he was the reverse: he encouraged open discussion and was receptive to his students' ideas. His supervision was stimulating and intense, with a 'what-have-you-discovered-today' style.

It was during this time (1958 ANZAS meeting) that my fellow student Arthur J. McComb and I attended the meeting in Adelaide at which the Australian Society of Plant Physiology was founded (later to become the Australian Society of Plant Scientists). This was an auspicious occasion, as the ASPP was to play a major role as a forum and influence throughout my future career. Denis debated with an eminent Biochemist whether Physiology or Biochemistry was the more important field of study. To me this seemed a futile question since both fields brought different and complementing information to the study of any plant phenomenon. As the ASPP developed, it quickly integrated these two fields to enrich our understanding of plant behaviour – as it were, a 3-dimensional view with two eyes rather than a 'flat' one-eyed view. I find it is very pleasing that the Society has so successfully assimilated other complementary fields, particularly molecular biology in recent years, to the benefit of all.

The ASPP was to play an important role in my future. From its early meetings there was a strong contingent of members investigating my field of plant water relations (eg. Dr Ralph Slatyer and Dr. Clive Gates). Apart from this, the wide scope and rigor of topics at ASPP meetings had a much needed

broadening and deepening influence on me. Contacts at the meetings resulted in the fruitful collaboration of my laboratory with Dr. Brian Loveys, Dr. Merv. Ludlow, Dr. Collin J. Brady, Dr. Nigel S. Scott and Dr. Jenneth M. Sasse.

As I prepared my thesis for a M.Sc., the option of presenting it after a further year for a Ph.D. was suggested to me. I decided to submit the M.Sc. and commenced a Ph.D. part-time combined with a position of Senior Demonstrator in the Botany School at the University of Melbourne. Whether or not this was the better professional decision is debatable, but in the event it enabled me to give physical support to my parents as my father declined for 5 years with motor neurone disease, while the experience in planning and supervising practical classes eased me into teaching and stood me in good stead during my later lecturing career at Monash University.

Soon after I commenced my Ph.D. research project (1959), Dr. Carr and his wife 'Maisie' (the lecturer in plant ecology) resigned to take up a Chair in Botany at Queens University in Belfast. Professor John S. Turner took over as my supervisor with an encouraging yet light-handed approach very different from Denis's. The ASPP 1959 Meeting in Canberra was the occasion of my first paper – and of my first public 'argument' when Dr. Purvis, a notable English plant physiologist, kindly supported my suggestion (that the large proportion of water in the cell walls of the sclerophyllous leaves of *Eucalyptus globulus* would act as a transient buffer against water loss from the cell protoplast) but took it to a degree that I thought was untenable. Peter Goldacre in the front row smiled benignly at the altercation. A second proposal, that the cell wall was the main path of water movement in the mesophyll, was supported later by EM studies with Professor Carrick Chambers and by extensive investigations by another ASPP member, Professor Martin J Canny.

The ASPP suffered two tragic losses – an elder of Plant Physiology in Australia, Professor J.G. Wood, before its second meeting and a few years later Dr P. Goldacre. Many years later, the 1997 meeting was disturbed to hear of the sudden deaths of two eminent members Professor R. Bruce Knox and Professor John A. Milburn shortly before the meeting.

'Bob' Robertson (later Sir Rutherford and Chair of RSBS at ANU) was a constant guiding presence at the ASPP meetings in its first four decades - his calm manner and wise council an incalculable asset to the Society. For the first decade or so, ASPP meetings were held in University lecture halls. The halls were provided free of charge, - implying the attitude that the stimulus science was worth much more to the University than the small costs incurred. Inexpensive accommodation and meals were available in associated residential colleges. Registration costs were accordingly small. The early meetings had only a single sequence of papers, giving the broadening benefit of all participants hearing all presentations. Meetings rotated between the capital cities of only the southeast of Australia (including Adelaide and Brisbane). Car travel between the cities was frustrated by major highways of one lane 'going' and another 'returning', both beset by numerous slow semitrailers that encouraged frustrated drivers into a roadway version of Russian-roulette. Our meetings benefited greatly from the presence of eminent plant scientists from overseas (mainly USA and the UK) who happened to be visitors to Australian Laboratories, particularly the CSIRO in Canberra. The ground-breaking research on C_4 photosynthesis by Hal Hatch and his co-workers was a powerful attraction to international plant scientists.

December 31st 1963 saw my fianceé Janet standing on the Sydney wharf waving me off as a P&O liner sailed off to the USA for postdoctoral research. A year and a day later we were married in California. Janet had to teach for that year or repay a prohibitively large bond to the Victorian Department of Education.

I had chosen to join Professor Jacob Levitt's laboratory in the Columbia Campus of the University of Missouri. Jake had written widely on the responses of plants to environmental stress, including a detailed and wide-ranging book reviewing the field. His recent hypothesis on the importance of protein sulfhydryl and disulfide groups in drought-induced injury and in plant hardening to abiotic stress was original, at a time when new directions for research in the field were rare. It also gave an opportunity to gain some experience in research into proteins. My results with drying cabbage plants indicated some protein denaturation and disulfide formation in membrane proteins just before terminal

injury. I also found Missouri is an interesting State at the crossroads of the country, - the junction of the 'North' and the 'South' in the civil war, central to river transport and the starting point for the nineteenth century trails across the plains of Kansas to California. Life as a bachelor in a Fraternity-house, the Gamma Alpha, in my first year in Columbia was very different from life as a newly-wed in the second year there.

Following my 2 years in Missouri, we returned to Melbourne to a lectureship at the Botany Department, newly founded at Monash University by Martin Canny. Monash University had been established for 5 years during which it had grown to 5000 students and was to reach 10,000 in the next 5 years. The experience of helping shape the growth of a new Department in a fresh young-staffed University was a stimulating experience. Well stocked spacious libraries were ideal for filling details of pertinent papers onto punch-hole index cards – the convenience of computer-base Endnote systems lay in the future decades ahead.

In 1969, as Victorian State Representative of the ASPP, I carried out the initial organization of the ASPP Meeting in May 1970 at the University of Melbourne. The ASPP was growing steadily but meetings were still relatively straight-forward and cheaper to arrange compared to present-day meetings (membership was 240 in 1970; Registration was $2!). Dr. John R.S. Lawton kindly took over as meeting organizer when I left for Africa in May. Later I led the Organizing Committee for the 1980 ASPP Meeting held at Monash University. The Society had grown to 640 members, as a consequence the size and complexity of the meetings had also increased greatly.

My attempts to obtain plants of the almost legendary 'resurrection bush' *Myrothamnus flabellifolia* by correspondence with South Africa had not been productive. So with study leave from Monash University in 1970, Janet and I sailed with our three children (under 5 years) on the Achilles Laura through the 'roaring forties' to South Africa to try to collect and study *Myrothamnus*. The main National Herbarium of the Botanical Research Institute at Pretoria received me most kindly. I have the fondest memories of the warm-hearted personnel of the Institute. All the staff spoke English, whereas Africaans was the default language of the tea-room and was far and away the main language of Pretoria – a good down-to-earth language with a relatively simple grammar.

With a grant from the Water Research Foundation of Australia, together with the advice of the BRI staff and collection-site information from the Herbarium sheets, I collected plants of *Myrothamnus* and of three other angiosperm species that together with some fern species had been reported to be resurrection species. Professor E. Schelpe at Capetown University suggested other possible fern species. I found that the water potential of the *Myrothamnus* leaves collected dry in the field corresponded to equilibrium with air of 30 to 40% relative humidity and that their protoplasmic drought tolerance corresponded to less than 1% RH! – very close to the theoretical optimal PDT of 0% RH. In the field it became clear that the desiccation-tolerant flora was much larger than the four angiosperm species reported. Mainly pioneer species on shallow soils, they were botanical curiosities rather than potentially useful species beyond research. It was exciting to discover the first desiccation tolerant grass, *Oropetium capensis*, on a collecting trip in Namibia with Willy Giess, Chief of the Windhoek Herbarium. Here was the demonstration that desiccation tolerant foliage existed in the agriculturally important family Poaceae. However, the *Oropetium capensis* plants were so minute (~2cm tall in the field), they could not have any practical importance. For many years afterward, I searched for other 'resurrection grasses', as opportunities could be made, mainly in Africa but also in Australia, India and the Americas. These collection expeditions were partly funded by the generosity of the Rural Credit Fund of the Reserve Bank of Australia, the Anglo-American Corpn. of S. Africa and Monash University. Of the 40 resurrection grasses uncovered, most were considerably taller than *Oropetium capensis*: two grasses bore leaves of about 30cm length. Gradually the African *Sporobolus stapfianus* emerged as the pre-eminent resurrection grass for use in laboratory studies. Many years later, a campaign by the media attacked the provision of study leave by universities. The study leave that I took in South Africa was seminal to investigations at Monash University over the past 4 decades, - involving collaborative studies on desiccation tolerance with 7 academic staff in plant sciences and a stream of research projects by postgraduate students. It also stimulated the study of desiccation

tolerance in plants in institutes in Europe, the USA and South Africa – with an exponential growth in the numbers of publications.

Physiological studies in my laboratory at Monash University found, in the angiosperm resurrection species investigated, that fully-hydrated leaf tissue was desiccation sensitive and that desiccation tolerance was induced by drought stress itself as the leaf water potential fell and passed through the range –3MPa to –14MPa during drying. In this range, resurrection angiosperms accumulate sucrose and LEA protein which protects cell membranes and proteins from denaturation. In the resurrection monocot *Borya constricta* desiccation tolerance can be induced in hydrated leaves by treatment with a single compound - abscisic acid. ABA, however, did not induce desiccation tolerance in the resurrection grass *Sporobolus stapfianus*. Drying produced major changes in the proteome of both species as drying leaves become desiccation tolerant. Presumably the last phase of the changes sets in place a protein complement suitable for the support of metabolic recovery during rehydration.

The ASPP/ASPS was of immense importance in stimulating exchange of ideas, collaboration in research, the enthusiasm of postgraduates for functional plant science, a forum for their first conference presentations and for exploring possible future research posts. Its influence spread naturally to the sister disciplines of agriculture, ecology, biophysics and biochemistry. Beyond plant physiology, two eminent members of the ASPP had major effects on science in Australia that continues still via Federal instruments funding research in Australia. Professor R.N. Robertson had initiated the Australian Research Grants Committee (ARGC, now the ARC) in about 1966. Later Professor Michael G. Pitman influenced the Government to establish the system of Cooperative Research Centres (CRC). Both play key roles in promoting research in this country. The ARC together with the Meat Research Foundation funded much of the research on the molecular biology of resurrection grasses at Monash University

I took over from Dr. W. John Cram as Secretary of the ASPP for the three year term 1979-1981 during which I pressed for a meeting (by then held each year) to be in Perth for the first time. The success of the Western Australian meeting (May1983) ensured that Perth was included in the regular rotation of host cities. ASPP membership and attendances at meetings had grown to the point where it had become very onerous on volunteer members in the host city to organize a meeting. Also costs of meetings were rising as political pressures that "user pays" moved Universities to charge for the use of their lecture halls. At this time the ASPP began to pay Honoraria to encourage guest speakers to come to Australia to address our Meetings and to visit laboratories here in their field. The time for joint conferences with other Societies in professionally managed Conference Centres was approaching rapidly. The last conference in which I led the ASPS Organizing Committee was in this latter mode, - the ComBio 1997 Conference held at the Conference Centre at Melbourne, shortly before my retirement from Monash University at the end of 1998.

My participation in research on plant desiccation tolerance has been most enjoyable. I am fortunate to have been able to follow a continuous thread of research on desiccation tolerance in its various aspects, without being diverted by changing fashions in State or Federal political thinking. I am also fortunate that, despite collecting in an area with leopard, camping out in lion territory, facing a rearing spitting cobra, a scorpion, a tick, being surrounded by a family of baboons who wondered what an earth I was digging for, and sitting only inches away from the head of a cheetah (tame!), nothing at all bit me.

An Honorary Senior Research Fellow position at Monash University has allowed me to continue some involvement in research on desiccation tolerant plants at Monash in collaboration with colleagues and students in molecular biology – a collaboration that has been academically fruitful and enjoyable. I have been fortunate that in the course of my studies I have met and been helped by an immense diversity of the most personable people – research students from many countries and technical staff who worked on the 'resurrection' project, fellow academics and people in the general public. Warm memories of them are treasured and I offer them my great gratitude for the generous help they have given me. I am especially indebted to Professor H Ziegler and Dr. Dorothea Bartels, who kindly hosted my study leaves in Germany, and to Hans Vahrmeijer, Benard de Winter, Willy Giess, Roger

Ellis, the Meindl family and to Gamal Fahmy for the huge help they gave me overseas, also to Peter Latz and Paul Kriedemann in Australia.

I am particularly grateful to my Molecular Biology colleagues at Monash, Cecilia Blomstedt, Robert Gianello, John Hamill and Alan Neale for their friendship and enthusiastic cooperation over the last two decades.

Dedication. I wish to dedicate this account to my wife Janet, and our children Clara, Rachel, Keith and Andrew who accompanied me on some fieldwork and performed tedious laboratory tasks, and, above all, give their love – and patience.

From Our New PhDs

Our recently completed PhDs who are the future of plant science and our society are encouraged to provide highlights of the research that earned them their new degree. Supervisors please encourage your graduating PhDs to contribute to this section of Phytogen.

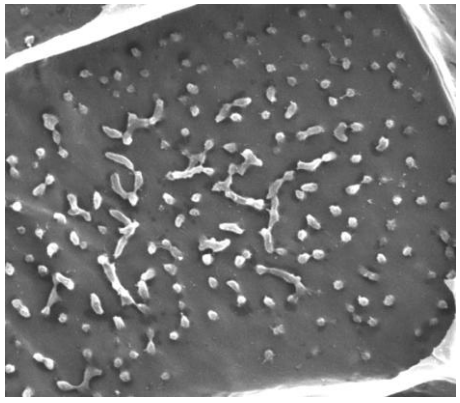
Tina Offler

Investigating signals that regulate transfer cell formation in Vicia faba *cotyledons*

Felicity Andriunas

Transfer cells (TCs) are specialised plant cells that support high rates of nutrient transfer. This function is afforded by the invaginated cell wall ingrowths that act as a scaffold for an amplified plasma membrane enriched in nutrient transporters. TCs are often located at bottlenecks for nutrient transfer (e.g. maternal and filial tissues of seeds) and play a crucial role in determining plant growth and crop yield. Development of TCs can also occur in certain species as an adaptive response to abiotic stresses (e.g. ion deficiency); a mechanism that has been hijacked by some plant parasites. However, in all these cases, little is known about the signals and signalling pathways that regulate their induction. My PhD set out to uncover the identity and role of these regulatory signals.

The *trans*-differentiation of TCs in, or proximal to plant tissues subjected to wounding, suggested that stress-responsive signal(s) may function as a key developmental trigger. Results of an AFLP analysis conducted by Dr Stephen Dibley pointed to ethylene as a possible regulator. We therefore examined its role in regulating induction of TCs. I utilised a unique experimental system in which adaxial epidermal cells of *Vicia faba* cotyledons are rapidly induced to form functional TCs when cultured on nutrient agar. To test specific hypotheses, a series of cell and molecular studies were undertaken. At the cell level, alterations to TC induction were monitored by determining impacts of cotyledon treatments upon relative numbers of their adaxial epidermal cells forming wall ingrowth papillae, the earliest visual indicators of TC induction.



SEM image of wall ingrowths induced to form *in planta* following wound-induced up-regulation of ethylene biosynthesis

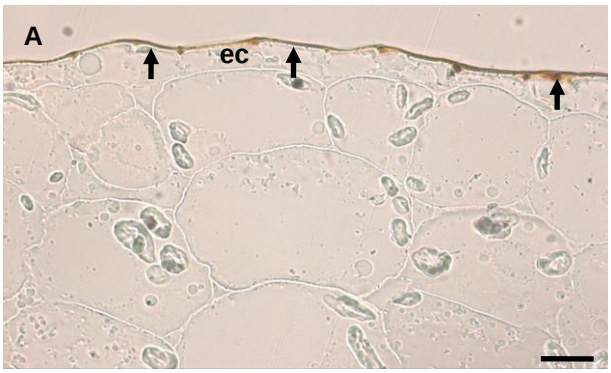
Manipulation of ethylene biosynthesis and perception indicated that ethylene is required not only for induction but also for ongoing development of wall ingrowths in adaxial epidermal TCs of *Vicia faba* cotyledons. Consistent with this conclusion, temporal and spatial expression patterns of ethylene biosynthetic genes demonstrated that a rapid and auto-regulated burst in ethylene biosynthesis and production coincided with adaxial epidermal cells becoming competent to form wall ingrowth papillae. Furthermore, the ethylene burst was primarily localised to adaxial epidermal cells. Protein abundance and gene expression profiles of key downstream ethylene signalling components, ethylene insensitive 3 (VfEIN3-1) and

three ethylene response factors, respectively, showed that ethylene-regulated signalling events occur rapidly and before wall ingrowth induction. Significantly, these events were also spatially restricted to adaxial epidermal cells forming wall ingrowths. Finally, our hypothesis was tested *in planta*, with results indicating that endogenously produced ethylene is capable of inducing wall ingrowth formation in adaxial epidermal cells of intact developing cotyledons.

The formation of TCs at sites of nutrient exchange suggested that solutes, in particular sugars, might also function as regulatory signals. Previous studies supported this theory, however the role of glucose remained unclear. To determine if glucose was acting to regulate TC induction, we utilised developing seeds of transgenic *Vicia narbonensis* harbouring a cotyledon–specific knock-down of ADP-glucose pyrophosphorylase expression. This provided the advantage of an *in planta* generated elevation in intracellular cotyledon glucose to study glucose effects on induction of *trans*-differentiation in adaxial epidermal cells.

In contrast to ethylene, glucose acted as a negative regulator of wall ingrowth induction, consistent with its ability to hold cotyledons in a dedifferentiated state. Manipulating intracellular glucose concentrations of *Vicia narbonensis* cotyledons through transgenic knock-down of ADP-glucose pyrophosphorylase expression and/or culture on a high glucose medium, lead to repression of wall ingrowth induction. Responses of wall ingrowth induction to culturing cotyledons on media containing glucose analogues were consistent with glucose acting through an hexokinase-dependent signalling pathway. Further studies suggested antagonism between the ethylene and glucose signals in regulation of induction. It appeared that glucose was acting to modulate the amplitude of ethylene-stimulated wall ingrowth induction through down-regulating expression of ethylene biosynthetic genes and *EIN3-1*. Overall, intracellular concentrations of glucose were envisaged to function as the gatekeeper, determining progression of the ethylene-signalling cascade through EIN3 to activate gene expression leading to wall ingrowth formation.

The theory that stress-associated signals may act as key regulators of TC *trans*-differentiation lead us to investigate reactive oxygen species (ROS). Pharmacological manipulation of ROS production or levels during cotyledon culture revealed that ROS play key roles in regulating induction of TC *trans*-differentiation in *Vicia faba* cotyledons. Furthermore, the response of wall ingrowth formation indicated that NADPH oxidase and super oxide dismutase activities are required to generate a regulatory H_2O_2 signal. The H_2O_2 signal was shown to be epidermal cell specific and significantly co-localised with the cellular site of wall ingrowth formation at the outer periclinal cell wall (see Figure). Temporal and spatial expression profiles of *respiratory burst oxidase homologues* (*Vfrboh*) coincided with those of extracellular H_2O_2 production. Here their transcript levels peaked prior to induction and specifically in the adaxial epidermal cell layer. These findings suggested rboh-encoded NADPH oxidase could be responsible for generating the regulatory ROS signal. In support of this, expression of *Vfrboh*s and subsequent ROS production was regulated by cross-talk with upstream ethylene/glucose signals to form a component of a signal cascade complex orchestrating wall ingrowth induction.



Diaminobenzidine staining of *V.faba* cotyledons showing H_2O_2 localisation (brown staining) to the outer periclinal wall of *trans*-differentiating epidermal cells (ec)

Overall this work furthers our understanding of TC formation, identifying ethylene, glucose and ROS as key regulators of initiation of *trans*-differentiation to a TC morphology. Research was performed collaboratively with those listed on the papers below. Thank you to my supervisor Professor John Patrick, co-supervisors Associate Professor David McCurdy and Professor Tina Offler and also the Plant Science Group at The University of Newcastle. This work was funded by an ARC Discovery Project and I was supported by an Australian Postgraduate Award.

Zhou, Y*, Andriunas, F*, Offler, CE, McCurdy, DW and Patrick, JW (2010) An epidermal-specific ethylene signal cascade regulates *trans*-differentiation of transfer cells in *Vicia faba* cotyledons. *New Phytologist,* **185:** 931-943. * equal first author

Andriunas FA, Zhang H-M, Weber, H, McCurdy DW, Offler CE and Patrick JW (2011) Glucose and ethylene signalling pathways converge to regulate *trans*-differentiation of epidermal transfer cells in *Vicia narbonensis* cotyledons. *Plant Journal*, **68:** 987-998.

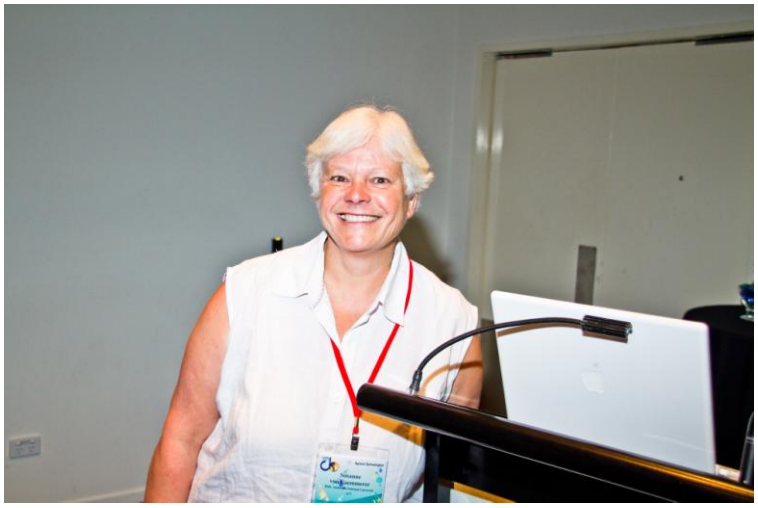
Andriunas FA, Zhang H-M, Xia X, Offler CE, McCurdy DW, Patrick JW (2012) Reactive oxygen species form part of a regulatory pathway initiating *trans*-differentiation of epidermal transfer cells in *Vicia faba* cotyledons. *Journal Experimental Botany (Accepted Dec 22, 2011).*

Some Highlights from Combio2011 - Cairns, Queensland

JG Wood Lecture -- Susanne von Caemmerer

The JG Wood Lecture was presented by Susanne von Caemmerer, FAA and Professor of Molecular Plant Physiology at the Research School of Biology, Australian National University. Susanne did her PhD under the supervision of Graham Farquhar and as part of a team presented a comprehensive mathematical model of the biochemistry of C3 leaf photosynthesis, which is now used worldwide.

Enhancing photosynthesis to improve crop yield



Susanne von Caemmerer

Plant Science Division, Research School of Biology, The Australian National University, Canberra, ACT 0200, Australia.

Biomass is produced by photosynthesis. Once a crop has been adapted to fully exploit the interception of sunlight and allocate the maximum amount of biomass to grain, further increases in yield will require enhancement of photosynthesis. This year marks the 50th anniversary of the Nobel Prize in Chemistry awarded to Melvin Calvin for the elucidation of the photosynthetic carbon reduction cycle. A large body of knowledge has been accumulated about photosynthesis and this can be used to formulate strategies for its enhancement. We have used molecular technologies to generate transgenic plants where photosynthetic carbon metabolism has been manipulated and these approaches, combined with mathematical modelling, can be used to develop strategies for improving crop yields. Some of these ideas where discussed by John Evans and myself in a brief opinion paper in Plant Physiology (von Caemmerer and Evans, 2010)and lead us to organise a Plant Physiology Focus issue on the topic.

In 1980 Graham Farquhar, Joe Berry and I published a mathematical model of C_3 photosynthesis (Farquhar et al., 1980; von Caemmerer and Farquhar, 1981). We showed amongst other things that CO_2 response curves of CO_2 assimilation as a function of intercellular CO_2 provided a quantitative link between photosynthetic biochemistry and leaf gas exchange. For example the initial slope of the curve can be used to estimate maximum Rubisco activity. The rate at high CO_2 can be used to calculate chloroplast electron transport rate (Figure 1). Thus the model allows us to use gas exchange measurements to infer photosynthetic biochemistry, but can also be used to predict gas exchange from biochemistry.

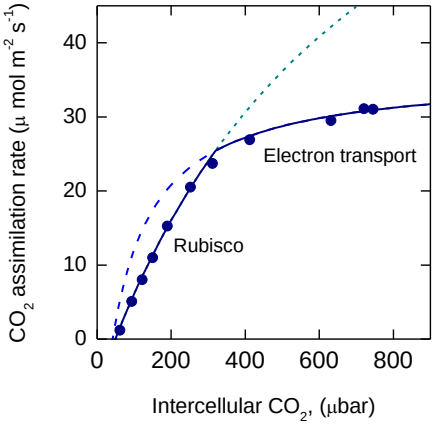


Fig. 1 Example of modelled and measured CO_2 assimilation rate as a function of intercellular CO_2 partial pressure. The dotted line gives the modeled Rubisco limited rate and the dashed line the electron transport limited CO_2 assimilation rate.

A recent example of this use was given by the research of Whitney and co-workers who used chloroplast transformation to engineer tobacco expressing mutant Rubiscos (Whitney et al., 1999; Whitney and Andrews, 2003) Using the in vitro kinetic constants of those Rubisco's it was possible to use the model to predict the characteristics of the expected CO_2 assimilation rate of these plants. Whitney and co-workers also used the model in the reverse direction and predicted Rubisco kinetic properties from gas exchange measurements. Our work with transgenic tobacco with antisense constructs to the Rieske Iron Sulphur protein of the cytochrome B_6f complex and to the ATPase have shown that increasing the cytochrome B_6f content is also likely to improve photosynthesis (Yamori et al., 2011). Now the model has been extended to in-cooperate a diffusion resistance from the intercellular airspace to the chloroplast and this allows us to model the effects of in-cooperating CO_2 pumps such as bicarbonate transporters at the chloroplast envelope (Price et al., 2011).

It is also worthwhile to consider enhancing C_4 photosynthesis as C_4 species include many important crops and biofuel species (eg. corn sorghum, sugarcane switch grass). C_4 photosynthesis is a biochemical CO_2 pump which requires the coordination of mesophyll and bundle sheath cells. Robert Furbank and I have used anti sense techniques in the C_4 dicot *Flaveria bidentis* to probe the coordination between the C_4 cycle which spans the mesophyll and bundle sheath interface and the C_3 cycle in the bundle sheath. Figure 2 shows the number of enzyme targets that have been investigated or are currently under investigation in our groups.

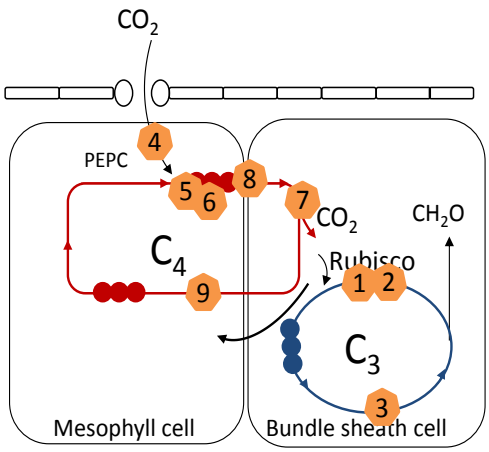


Fig. 2 A picture of *Flaveria bidentis* alongside a schematic of the C_4 photosynthetic pathway highlighting the enzyme targets that have or are being investigated 1) Rubisco, 2) Rubisco activase, 3) SBPase, 4) Carbonic anhydrase, 5) PEP carboxylase, 6) PEPC phosphokinase, 7) Malic enzyme, 8) Pyruvate Pi dikinase, 9) NADP malate dehydrogenase.

The C4 pathway is primarily designed to provide Rubisco with a high CO_2 environment in the bundle sheath and our transgenic work showed that increasing Rubisco content or manipulating its kinetic constants may also be a valuable strategy for enhancing C_4 photosynthesis. Some of this evidence also derived from a study done by Oula Ghannoum who looked at the nitrogen use efficiency of C_4 grasses and showed that variation in the catalytic turnover rate of Rubisco was the main driver of differences in photosynthetic nitrogen use efficiency (von Caemmerer et al., 1997; Ghannoum et al., 2005). These results also suggest that there is value in screening germplasm of C_4 species for variation in Rubisco kinetic properties.

We have used concurrent measurements of carbon isotope discrimination and gas exchange to look at the coordination of the C_3 and C_4 cycles of C_4 photosynthesis relying on carbon isotope theory developed by Farquhar (Farquhar, 1983). The question that continues to exercise our minds is how the biochemistry of the two cycles is coordinated. So far our transgenic studies with *F. bidentis* have shown that when we reduce a target enzyme such as Rubisco, or malic enzyme, we reduce the flux of the cycles they occur in without affecting the other cycle. From this we have concluded that photosynthetic metabolites are not the drivers of this coordination which we know occurs with environmental perturbation.

Understanding how photosynthetic biochemistry is coordinated is one important aspect in the pursuit of enhancing both C_3 and C_4 photosynthesis.

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Annals of Botany Lecture -- Carroll Vance

This lecture, sponsored by the Annals of Botany, was presented by Professor Carroll Vance a research leader within the Department of Agronomy and Plant Genetics at the University of Minnesota. Vance has been involved in legume N_2 fixation, N and C metabolism and plant-microbe interaction research for more than 30 years. Most recently, he has been an international l leader in the functional genomics of symbiotic nitrogen fixation and root responses to P-deficiency. Vance delivered his interesting and thought-provoking lecture based on his wide experience of gene sequencing. The abstract of his lecture is reproduced below.

LEGUME BIOLOGY: SOLVING PROBLEMS UTILIZING NEXT GENERATION SEQUENCING

Vance C.[1], Severin A.[2,] O'Rourke J.[1], Bucciarelli B.[1], Bolon Y.-T.[1], Yang S.[1] and Gronwald J.[1]
[1]USDA/Agricultural Research Service, Agronomy and Plant Genetics University of Minnesota, St Paul. [2]Agronomy Department, Iowa State University, Ames IA.

High throughput sequencing of DNA and RNA is rapidly becoming a standard approach for the analysis and identification of genetic factors contributing to plant genome evolution, organ development, tolerance to abiotic/biotic stress, and seed nutritional quality. The focus of our research has been to understand and define the fundamental genetic and molecular mechanisms contributing to legume organ development and acclimation to nutrient stress. We have been particularly interested in legume root and seed development along with legume root nodules. Since production on some 50% of the World's soils is phosphorus limited we are investigating genes involved in root acclimation to phosphorus deficiency. White lupin (*Lupinus albus*) is well acclimated to phosphorus deficiency due to the development of cluster roots. We have undertaken characterizing the cluster root and leaf transcriptome of white lupin grown under phosphorus deficiency. Iron deficiency chlorosis is a serious problem in the Upper Midwest of the U.S. and can significantly reduce soybean (*Glycine max*) crop yield and quality. Using near isogenic lines and next generation RNA sequencing (RNA-seq) we have defined genes responding to iron deficiency and mapped them to the soybean genome. Common bean (*Phaseolus vulgaris*) is a primary staple for a large proportion of the World's population but few genomic resources are currently available for this important species. Using RNA-seq we have identified transcripts specific to root nodules, roots, leaves, stems, flowers, pods, and seeds. High throughput sequencing approaches with several legume species has allowed: 1) the identification of genes and pathways contributing to plant acclimation to nutrient deficiency stress; 2) the development of a gene expression atlas for three legume species and 3) high resolution characterization of important genic regions introgressed into soybean contributing towards tolerance to iron deficiency chlorosis and enhanced seed protein.

Symposium Reports

Symposium 10: Sugar Partitioning, Transport and Plant Productivity

Chairs: Anne Rae (CSIRO Plant Industry, Queensland)
Yong-Ling Ruan (University of Newcastle, NSW).

Despite the attractions of the beautiful tropical environment just outside the windows, a crowd of plant scientists gathered on Monday afternoon at ComBio 2011 in Cairns to hear about advances in "Sugar Partitioning, Transport and Plant Productivity". Carbohydrate biosynthesis, transport and storage are central to plant metabolism. During vegetative growth, sugars are transported to sinks like the shoot apex to fuel cell division and expansion, or stored in various forms and locations depending on the species. Remobilisation of these stored sugars is important during reproductive development and has a major impact on yield of crops such as wheat. Recently, the development of bioenergy crops has renewed interest in how sugars are partitioned between storage carbohydrates and cell wall polymers. The five speakers in the session addressed different aspects of this complex network.

In cereal plants, developing anthers are particularly sensitive to cold and drought stress. **Rudy Dolferus** from CSIRO Plant Industry in Canberra showed that abiotic stress reduces the sink strength of anthers by suppressing cell wall invertase and sugar transporters. Rudy also presented evidence that ABA mediates this response; both sink strength and cold tolerance were increased in transgenic plants with reduced ABA.

My symposium co-chair, **Yong-Ling Ruan** from the University of Newcastle, presented the second talk in the session. Yong-Ling also focussed on the fate of sugars after phloem unloading, by investigating the regulation of cell wall invertase. Post-translational regulation of the invertase by an invertase inhibitor protein appears to be a mechanism that allows precise modulation of sink strength and could be exploited for improving crop productivity.

In the third talk, **Cristiana Dal'Molin** from the Australian Institute for Bioengineering and Nanotechnology at the University of Queensland, described a systems biology approach to understanding source-sink relations. In Cristiana's work, genome-scale metabolic models for C3 and C4 plants were constructed and shown to be accurate in predicting metabolic fluxes during photosynthesis. The models are now being used to guide selection of targets for metabolic engineering.

The biosynthesis of a storage carbohydrate, barley grain starch, was the topic of the talk by **Regina Ahmed** from CSIRO Plant Industry in Canberra. Mutants or transgenic lines with RNAi-induced silencing were used to pinpoint the activities of enzymes involved in starch synthesis. The altered starches were tested for their functional properties, aiming to increase the proportion of resistant starch for a healthier diet.

The final talk in the session, presented by **Rachel Burton** from the ARC Centre of Excellence in Plant Cell Walls at the University of Adelaide, also focussed on cereal grains. In addition to starch, the endosperm contains carbohydrate reserves in the form of cell wall polysaccharides including the (1,3;1,4)-β-D-glucan. New information on the genes involved and their regulation may now allow the wall composition to be manipulated for particular dietary or industrial applications.

Anne Rae
Principal Research Scientist
CSIRO Plant Industry, Brisbane

Symposium 17: Responses to Temperature and CO_2

Chair: Michael Tausz (University of Melbourne, Victoria)
Co-organiser: Fernanda Dreccer

This symposium brought together Australian leading scientists in the field of plant responses to key components of climate change, increasing atmospheric CO_2 concentrations [CO_2] and increasing temperatures. Presentations gave a broad range of aspects from detailed studies of aspects of CO_2 assimilation as investigated by cutting edge technology to the important question of how knowledge of physiological mechanisms can be translated into breeding strategies to create new crop varieties fit for the future.

Oula Ghannoum (University of Western Sydney, Richmond, Australia) presented results from the first study of two Eucalyptus species, a slow and a fast growing one, under [CO_2] and temperature conditions from pre-industrial to mid-21st century. Under ample water and nutrient supply in glasshouses, increasing [CO_2] stimulated growth, photosynthesis, and nitrogen (N) uptake, but decreased N concentrations in leaves. Increasing temperatures stimulated photosynthesis but had only small effects on N uptake and tissue N. Complex interactions were found with regard to functional and structural water relation parameters.

David Tissue (University of Western Sydney, Richmond, NSW, Australia) reported on growth and physiological performance of two cotton genotypes under increasing [CO_2] and temperatures. Whilst both elevated CO2 and higher temperature stimulated growth, elevated [CO_2] also led to better water use efficiency of cotton plants, and elevated temperature stimulated respiration rates. Perhaps surprisingly, there were no interactions between higher temperatures and elevated [CO_2], but effects seemed largely additive and independent.

Scott Chapman (CSIRO Plant Industries, St. Lucia, QLD, Australia) underlined the challenges rising [CO_2] and climate change pose for crop breeders, because large changes predicted for 2050 (such as a 40% increase in [CO_2], or potentially 2 °C higher average temperatures) are only 2-5 breeding cycles away. He presented a framework for improved identification of adaptive traits and adapted genotypic lines in wheat, drawing together experimental studies and modelling approaches. Field and enclosure studies on elevated temperatures, drought, and elevated [CO_2] examine potential adaptive traits, and improved biophysical models can then be used to extrapolate such trait evaluation to other parts of the country.

John Evans (Australian National University, Canberra, ACT, Australia) reported on experiments using the cutting edge tuneable diode laser spectroscopy technique to determine the temperature dependence of mesophyll conductance in tobacco. Mesophyll conductance is an often neglected aspect of [CO_2] assimilation and a potential limitation and determinant of assimilation response to [CO_2]. The experiments showed a temperature dependent increase in mesophyll conductance from 10 to 40 °C, resulting in a decrease of the drawdown in [CO_2] between intercellular space and the chloroplast under higher temperature.

Saman Seneweera (University of Melbourne, Horsham, VIC, Australia) showed results from the Australian Grains Free Air CO_2 Enrichment (AGFACE) experiments, jointly run by DPI Victoria and the University of Melbourne. Growth under elevated [CO_2] significantly decreased grain protein content of wheat. Proteome analyses showed qualitative changes with potentially negative effects on functional and nutritional properties of wheat flour. Differences among wheat cultivars established links to plant nitrogen metabolism and may offer avenues for adaptation through breeding and trait selection.

Reported by Michael Tausz, Michael.tausz@unimelb.edu.au

Symposium 23: The Molecular Biology of Plant Form and Function

Chair: Martha Ludwig (University of Western Australia)

The talks in this symposium covered multiple aspects of plant form and function, including the determination of cell shape, control and signaling of plant organ development, and the regulation of chloroplast and cytosolic isozymes.

Julian Hibberd (University of Cambridge) reported the latest results he and co-workers have on the cytosolic and chloroplastic forms of the Arabidopsis pyruvate, orthophosphate dikinase (PPDK) regulatory protein (RP). They have shown, contrary to previous evidence, that both isoforms have both phosphotransferase and kinase activities that contribute to the post-translational regulation of PPDK. They have also begun to characterise the site-specific molecular interactions of the RPs and PPDK. Regulation was also a major focus of three other talks in the session. Christine Beveridge (University of Queensland) presented work from her group that indicates shoot branching is affected by the interplay of strigolactones, plant hormones affecting multiple developmental pathways by influencing meristematic activity, and auxin. Mark Waters (Plant Energy Biology, University of Western Australia) highlighted the structural relatedness of strigolactones and karrikins, and a genetic approach being used to determine how these compounds function in distinct developmental pathways. Trehalose-6-phosphate (Tre6P), a precursor of the disaccharide trehalose, plays an important role in several plant developmental pathways. John Lunn (Max Plank Insititute) provided evidence for its mechanism of action, showing that Tre6P levels reflect the sugar status of a plant and its metabolism is linked to shoot development and growth. Insights into the changes in cell shape that occur during development of epidermal cells in Arabidopsis cotyledons were given by Will Armour from Robyn Overall's group at the University of Sydney. An elegant system by which these developmental changes were monitored in the same living cell over time was described, and beautifully illustrated the process of initiation and growth of epidermal cell lobes from precursor cells with straight walls.

Martha Ludwig

The Goldacre, Best Paper and Teaching Awards

The Goldacre Award -- Chanyarat Paungfoo-Lonhienne

Peter Goldacre was a foundation member of ASPP, and an enthusiastic supporter of the Society from its inception. Peter was an enthusiastic researcher who was held in great respect by his peers. His tragic death in 1960 at age 34 shocked and saddened all his friends and colleagues. The Goldacre Medal was subsequently established as a lasting tribute to his contributions in plant physiology, and as an encouragement to young researchers.

Functional Plant Biology now sponsors the Goldacre Award. The Award is made on the merit of original research in one area, the findings of which have been published, or accepted for publication, in the three years preceding the year of the Award. The work should have been done within 10 years of the candidate submitting their PhD.

Chanyarat Paungfoo-Lonhienne (The University of Queensland) was awarded the Goldacre Medal for her innovative and significant work on organic nutrients and plant nutrition and gave a very impressive plenary talk. She is seen in this photo being presented her award by Ros Gleadow, ASPS President. The abstract of her talk is provided below.

RETURNING OF ORGANIC NUTRIENTS IN PLANT NUTRITION RESEARCH

Paungfoo-Lonhienne C.[1], Vesser J.[2], Lonhienne T.[3], Nasholm T.[4], Rentsch D.[5] and Schmidt S.[1]

1School of Agriculture and Food Science, The University of Queensland, St. Lucia QLD, 4072, Australia. 2Wageningen University, 6708 WG Wageningen, The Netherlands. 3School of Biochemistry and Molecular Biosciences, The University of Queensland, QLD, 4072, Australia. 4Dept of Forest Ecology & Management, SLU, SE-901 83 Umea, Sweden. 5Institute of Plant Sciences, University of Bern, 3013 Bern, Switzerland.

It was standard agricultural practice to apply animal wastes and plant residues to replenish the nutrients removed with the harvest product in crop systems ('humic' period). During the 20th century, the 'mineralist' period saw a pronounced shift towards the use synthetic nitrogen (N) and mineral fertilisers. Increased application of fertilisers, improved crop varieties and agronomic practices enabled today's high- yielding crop production. However, these advances come at great cost. Pollution of atmosphere, hydrosphere, and pedosphere with reactive N is considered a global problem. Extreme rates of 1000 kg N per hectare in expanding economies like China and India are accompanied by enormous off-site N losses. It is a formidable challenge to transform crop production to reduce pollution and dependency on energy-intensive fertiliser production and finite natural resources, while increasing food production for a growing human population. What practices can deliver high crop yields at low environmental costs? One avenue may be to decrease reliance on synthetic and mineral fertilisers by successfully incorporate organic nutrients into agriculture. Evidences are emerging on the ability of plants to access organic forms and to undergo physiologic changes in order to optimise this process. There is much opportunity to successfully incorporate organic nutrients to improve nutrient use efficient agriculture, but knowledge has to be obtained to ensure optimal use by crops and crop systems.

ASPS-FPB Best Paper Award – Helen Bramley

This award is for a paper published by an early career scientist in Functional Plant Biology in each calendar year. The winner of the award is invited to present an oral paper at the ComBio conference in the year following the award. To be eligible for the award, the first author must be a member of ASPS or NZSPB and a PhD candidate or no more than 10 years post-PhD.

Helen Bramley (UWA, Institute of Agriculture, WA) received the award for 2011 from Rana Munns, Editor-in-Chief, FPB for her paper on the effects of hypoxia on wheat and lupin roots. Below is her account of her research and what it has meant to her to win this award.

Helen receiving her award from Rana Munns, Editor-in-Chief, Functional Plant Biology

Helen has written:

I am extremely grateful to Prof. Rana Munns, Assoc. Prof. Ros Gleadow, the ASPS committee and Functional Plant Biology for selecting my work for the Best Paper Award. The award is a great initiative that promotes the work of early career plant scientists. It reflects the support in Australia for ECRs by the plant science community, and I appreciate the encouragement and advice I have received, both as a student and postdoctoral fellow at the national meetings such as ComBio.

I would like to acknowledge and thank my co-authors, who were also my PhD supervisors - Prof. Neil Turner, Prof. Steve Tyerman and Assoc. Prof. David Turner, for their contribution to the paper and support during my candidature, and their ongoing mentorship.

The paper examined the effects of hypoxia on the hydraulic properties of wheat and lupin roots. Hypoxia is one of the main components of soil waterlogging, which is a significant problem to agriculture as most crops are not adapted to overly wet conditions. We focused on wheat and lupins in the study because they often experience transient waterlogging during the winter growing season. Our previous work identified that wheat and lupin roots have contrasting hydraulic properties, particularly in the region of root that absorbs water and the contribution of aquaporins in transporting water across the root. The FPB paper advanced on this and showed that hypoxia inhibited aquaporin-facilitated water transport across root cell membranes. The effect was reversible in wheat, but lupin roots were particularly sensitive and became leaky, losing solutes and cell turgor pressure.

I remember how difficult it was to obtain the measurements for this paper. The combination of impaling cells with a pressure probe while maintaining a constant hypoxic environment was challenging, but patience and perseverance identified new details relating to the tolerance of these important crop species to soil waterlogging. It is therefore, especially motivating to win the award for this research.

Teaching Award – Gonzalo Estavillo

This award recognises excellence, innovation and/or contributions to teaching to undergraduate students at an Australian University in any area of plant science. The award is made annually when a suitable candidate is nominated. The recipient is invited by ASPS to give a short presentation on her/his teaching methods, innovations or contributions at the annual ComBio conference.

The Teaching Award was presented to Gonzalo Estaville (Australian National University, ACT). At ComBio Gonzalo received his award from Ros Gleadow, ASPS President before giving an inspiring talk in the teaching symposium on “Plant detectives”.

Gonzalo with his award before delivering his talk on “Plant detectives.” The abstract and Gonzalo’s coauthors are on the next page.

PLANT DETECTIVES: INNOVATIVE APPROACH TO RESEARCH-LED DRIVEN TEACHING

Estavillo G.M., Mathesius U., Beckmann E. and Nicotra A. The Australian National University.

The next generation of plant science graduates will need creativity backed by high quality knowledge and investigative skills if they are to tackle the challenges of food production and biodiversity management in the face of climate change. The class Plants: Genes to Environment (BIOL2121) is the key course introducing plant science to undergraduates at the Australian National University (ANU). This research-led class features an interactive approach by research-active staff and innovations such as the inquiry- based identification of plant mutants (Plant Detectives), engaging approaches to assessment, and the appointment of Peer Mentors. In the Plant Detectives project, teams of students put into practice their theoretical knowledge as they apply cutting-edge laboratory techniques to identify Arabidopsis mutants. I will describe the design and implementation of the Plant Detectives approach, as well as some of the outcomes from this class since the new format was carried out.

Posters, Poster Prizes and Socializing

Poster Prizes

Three students were awarded poster prizes. As we have come to expect from our young scientists, the standard was very high and the judges found it hard to choose the most outstanding.

Congratulations to the following students who received awards.

Jessica Bovill (ACFPG, University of Adelaide)
Poster entitled: Characterisation of the barley V-PPase (HVP10), a candidate gene for salinity tolerance.

Sandra Schmoeckel (ACFPG, University of Adelaide)
Poster entitled: Regulation of AtHKT1;1 expression, a gene encoding for a sodium transporter in plants.

Michael van der Kwast (University of Western Australia)
Poster entitled: Bimolecular fluorescent complementation analysis of the plant specific histone deactylase family and its interaction with 14-3-3 proteins in Arabidopsis thaliana.

The recipients received their awards from Ros Gleadow, President , ASPS. See photos and poster abstracts below.

CHARACTERISATION OF THE BARLEY V-PPASE *(HVP10)*, A CANDIDATE GENE FOR SALINITY TOLERANCE

Bovill J.[1,] Afzal I.[2,] Hayes J.[1,] Roy S.[1,] Shavrukov Y.[1] and Tester M.[1]
[1]Australian Centre for Plant Functional Genomics and University of Adelaide, PMB1 Glen Osmond, SA 5064. [2]Department of Crop Physiology, University of Agriculture, Faisalabad-38040, Pakistan.

Salinity is one of the most significant abiotic factors adversely affecting cereal production in Australia and around the world. Near wild relatives of cereals offer a potential source of genetic alleles for salinity tolerance as they are adapted to a broad range of environmental conditions. A major quantitative trait locus (QTL) for sodium exclusion (*HvNax3*) has been identified in the barley mapping population Barque-73 (Hordeum vulgare; a high yielding South Australian cultivar) x CPI-71284-48, (a wild barley; Hordeum spontenum). Fine mapping of this region has reduced the number of candidate genes underlying *HvNax3* to five, the most promising of which encodes a Vacuolar Pyrophosphatase Proton Pump (V-PPase, *HVP10*). The protein encoded by this gene is responsible for establishing an electrochemical gradient across the tonoplast that allows other transporters such as Na+/H+ antiporters to transport sodium into the vacuole, thereby reducing the toxic effect in the cytosol. Orthologues of this gene have been shown to confer salinity and drought tolerance in a variety of plant species. The aims of this project are to: 1) confirm that V-PPase is responsible for *HvNax3* sodium exclusion QTL; 2) characterise the V-PPase in planta in Barque-73, CPI-71284-48 and near-isogenic lines (NILs) in

response to salt stress; 3) generate transgenic barley plants with constitutive and stress-inducible expression of *HVP10*; and 4) develop GFP and GUS promoter and gene fusion constructs to determine tissue distribution and sub-cellular localisation of *HVP10*. Results will be presented characterising the in situ expression of the *HVP10* gene and its effect on barley salinity tolerance.

REGULATION OF *ATHKT1;1* EXPRESSION, A GENE ENCODING FOR A SODIUM TRANSPORTER IN PLANTS

Schmoeckel S.M., Sundstrom J.F., Tester M. and Roy S.J. Australian Centre for Plant Functional Genomics and the University of Adelaide, PMB 1, Glen Osmond, SA 5064, Australia.

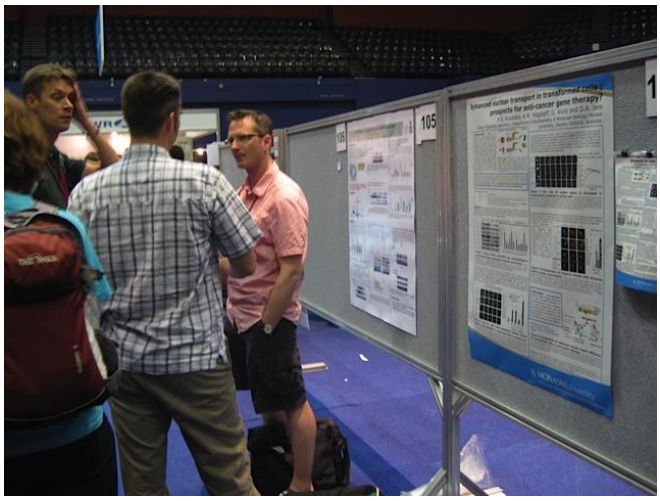
Abiotic stress caused by salinity is a major threat to agriculture, resulting in reduced crop yields and endangering food security. With a continuously increasing land area affected by salinity, the understanding of the molecular mechanisms concerning salt affected plants is of heightened importance. Elevated Na+ levels lead to osmotic and ionic stress, both having significant effects on the plant's performance and yield. The accumulation of Na+ in the shoot has in particular been shown to be detrimental. The Na+ transporter AtHKT1;1 is reported to be located in the xylem parenchyma where it is involved in retrieving Na+ from the xylem, thereby reducing the amount of Na+ transported to the shoots. The Arabidopsis thaliana ecotype C24 was found to lack *AtHKT1;1* expression in the roots and consequently accumulated significantly higher amounts of Na+ in the shoot compared to the Col-0 ecotype. A tandem repeat 4 kb upstream of the start codon has been reported to enhance *AtHKT1;1* gene expression. We have observed significant polymorphisms within this region between C24 and Col-0 ecotypes. In addition, we have discovered significant sequence polymorphisms in other areas of the promoter and within the gene itself. Here we show that despite a disrupted CAAT motive, the highly polymorphic region 50 bp upstream of the start codon has only minor influence on the expression of *AtHKT1;1*. Furthermore, we investigate the role of a 1.6 kb insertion in the second intron of C24 on the expression of the gene.

BIMOLECULAR FLUORESCENT COMPLEMENTATION ANALYSIS OF THE PLANT-SPECIFIC HISTONE DEACETYLASE FAMILY AND ITS INTERACTION WITH 14-3-3 PROTEINS IN *ARABIDOPSIS THALIANA*

Van der Kwast M.R., Lui H.C. and Martin T. School of Biomedical, Biomolecular and Chemical Sciences, University of Western Australia, Crawley WA.

The histone deacetylase 2 (HD2) gene family is unique to plants and comprises four members in *Arabidopsis*, named HD2A-D. HD2A-C have been identified as down-regulators of gene transcription with principle roles in development, stress response, and as negative regulators of elicitor-induced cell death. While the regulation of these proteins remains unknown, from their initial discovery it was evident that they were phosphorylated,

and subsequent large-scale proteomic screens have identified HD2 as a putative target for 14-3-3 proteins. 14-3-3 proteins are ubiquitously expressed in eukaryotes and function by binding to specific phosphorylated serine and threonine residues on a target protein. Binding has been identified between 14-3-3s and a number of diverse targets, suggesting that their role is not limited to any single biochemical process. What is common, however, is that14-3-3 binding can induce an alteration in function, localization or degradative state of the target protein. In this study, HD2A-C and 14-3- 3 proteins have been shown for the first time to interact *in planta*, using Bimolecular Fluorescent Complementation (BiFC). Utilizing this method, a deletion series of HD2C proteins was screened with 14-3-3 epsilon to identify the specific site of 14-3-3 binding. Results indicate that HD2C contains multiple 14-3-3 binding sites within its N-terminal domain. As phosphorylation has been linked to enzymatically active HD2, and the conserved 14-3-3 binding sites are within the enzymatic N-terminal domain, this suggests that a 14-3-3 is centrally involved in regulating the activity of the HD2 family of proteins.



First concentrate on posters and then the ASPS dinner. Thanks Graham Bonnet for organizing a great night.

A note from the President: ComBio2011 Abstracts Available

If you would like a copy of ComBio2011 Abstracts please e-mail Ros Gleadow at: Ros.Gleadow@monash.edu.au

RN Robertson Travelling Fellowship

The objective of the Professor R.N. Robertson Fund is to encourage young Plant Scientists to participate in mechanistically (functionally) orientated research in a discipline that differs from their own. The Fund has been used to set up The RN Robertson Travelling Fellowship to recognise and celebrate the sustained contribution made by RN Robertson (Sir Bob) in nurturing plant scientists in Australia spanning across four decades from the 1950s.

The Travelling Fellowship is focused on support for graduate students and recent PhD graduates to undertake research aimed at elucidating plant function and should enhance the current research of the applicant by providing access to expertise and facilities outside of that currently available to them. The fellowship should be undertaken at another institution outside of the Australian state in which their current research institution resides. For overseas applicants, the proposed host research institution must be within Australia.

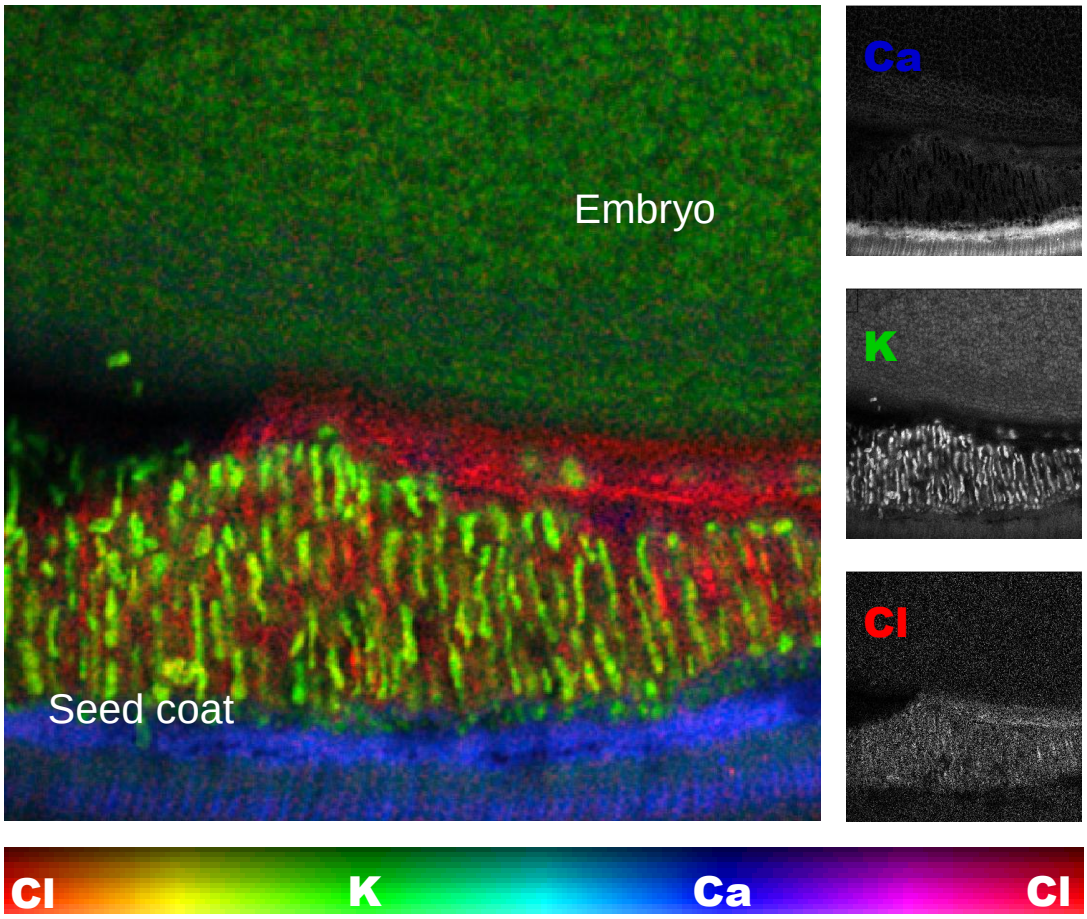
Report by 2010 recipient Lydia Guja

Recently I was fortunate to visit the Microstructural Analysis Unit at the University of Technology Sydney thanks to the award of the R. N. Robertson travelling fellowship by the Australian Society of Plant Scientists. I am a PhD student from Curtin University and the Botanic Gardens and Parks Authority in Perth, Western Australia. My PhD investigates the possibility of oceanic dispersal in seeds of native coastal plants by examining seed biology and seed physiology.

I have found that despite co-occurring along our beaches, seeds of Australian coastal species differ in their ability to survive and germinate in salt, and recover when salinity is alleviated. To understand the various salt responses of seeds I have been investigating whether salt is taken up during germination. Seeds of one salt-tolerant (*Ficinia nodosa,* Knotted Club Rush) and one salt-sensitive (*Spyridium globulosum*, Basket Bush) species were exposed to varying salt concentrations. Flame photometry was used to quantify the amount of salt imbibed by seeds, however, only revealed the average amount of salt within an entire seed, providing no information on its spatial distribution. It remained unclear where salt was located within a seed, and whether it was partitioned into particular tissues.

To resolve these questions I spent a very productive seven weeks in Sydney working with Dr Richard Wuhrer and Professor Matthew Phillips from the Microstructural Analysis Unit at the University of Technology Sydney, and Ken Moran of Moran Scientific. I am extremely grateful to them for welcoming me to their lab, and for their guidance and mentoring. Together we collected X-ray maps with scanning electron microscopes (SEM) equipped with energy dispersive spectrometers (EDS) and wavelength dispersive spectrometers (WDS) to identify the areas where elements such as sodium and chlorine were concentrated within germinating seeds. I was given a "crash course" in X-ray mapping and taught how to visualise results and extract data using Moran Scientific software, a task that would have been near impossible via email and telephone!

I have returned to Perth with lots of data to process and am now trying to understand the relationship between salt uptake patterns, external salt concentration, and time (from imbibition to radicle emergence). We believe that this is the first time the spatial distribution of salt in germinating seeds has been mapped and we look forward to creating a manuscript reporting these results. Thank you to the staff and students at UTS who assisted me and made my visit productive and rewarding, and to ASPS for awarding me the fellowship and making this cross-disciplinary research possible.



Pseudo colour and X-ray maps are very useful for resolving the spatial distribution of elements within seed tissues. Here we see a portion of a sectioned *Hardenbergia comptoniana* seed showing the distribution of calcium (blue), potassium (green), and chlorine (red) through the embryo and layers of the seed coat. The greyscale maps on the right indicate where each element is located. White areas reflect the highest concentrations and black areas indicated absence. Moran Scientific software allows us to post-process and quantify these data in many ways. One example is the pseudo colour image on the left. This technique can be used to visualise where elements occur, and co-occur, using the colour scale at the bottom of the image.

Lydia Guja on a seed collecting trip along the Western Australian coast.

Update on:

Functional Plant Biology

Editor-in-Chief: Dr Rana Munns

The 2011 impact factor for Functional Plant Biology has increased significantly over the last year, and is running at about 2.8. The papers in the evolution series, and the special issues on drought and salinity, are particularly well cited.

FPB has a rejection rate of about 75%. It is finding its niche in the environmental biology arena, and on cross-discipline studies that integrate across different levels of organisation such as cellular and whole plant. Special Issues (arising from a conference) provide interest for the journal, and Research Fronts (a smaller number of papers on a focussed issue) act to highlight specific areas and draw attention to papers published as a group that may not get the same recognition if published separately.

This year there have been three Special Issues or Research Fronts:

- Root Systems for Dry Environments (Volume 38 Issue 5)
- Actinorhizal Plants (Volume 38 Issues 8 & 9)
- Beans in the Tropics (Volume 38 Issue 12)

For 2012, four special issues are in progress:

- Plant Phenomics (Guest Editors Hendrik Poorter and Roland Pieruschka)
- Phenome to Genome (Guest Editor Rudi Appels)
- Crops for a Future Climate (Guest Editors Ros Gleadow and Michael Tausz)
- Halophytes (Guest Editor Tim Flowers)

Editor-in-Chief, Rana Munns

Update on:

Plants in Action

The first edition of ***Plants in Action'***, published in 1999 by the Australian Society of Plant Scientists, along with the New Zealand counterparts, is now on-line and free.
http://plantsinaction.science.uq.edu.au/edition1/

It is hosted by the University of Queensland, thanks to Professor Susanne Schmidt who has worked tirelessly to bring this to fruition. The major sponsor is the Australian Centre for International Agricultural Research (ACIAR), along with the University of Western Australia, University of Western Sydney, and the Australian Centre for Plant Functional Genomics (ACPFG).

The revised second edition of ***Plants in Action*** is well underway. Each chapter has an editor and several co-authors. An editorial assistant (Jen Price) is providing help in downloading text and images from the first edition, and formatting text for the revised edition. An IT expert will place the text and the images on the web. A password will apply until authors are happy with the final chapter, which will then be lifted so it becomes open access. There are some funds available for a graphic artist to draw complex diagrams.

The first six chapters, and most of the following ones, will be ready for the start of the academic year in 2012.

Rana Munns

THE PLANT NUTRITION AWARDS

THE PLANT NUTRITION TRUST has been established to encourage and promote research and technology transfer in the mineral nutrition of plants, soil fertility and fertiliser and soil amendment technology, and includes areas where these impinge on other fields such as plant breeding.

THE TRUST invites applications for awards to assist in carrying out a study tour or to attend a conference or such other activity related to the stated objectives.

Awards will be made to an outstanding early-career scientist working in the areas mentioned above. More than one award may be made, depending on the applications received.

In making an award an applicant's scholastic achievement and recent contribution to industry, research or technology transfer, and their potential for future contribution will be considered. The amount of each award will depend on circumstances but is likely to be under $2,000.

Applicants must be Australian citizens or permanent residents and be based in Australia,

Applications for the next round close on **29 February 2012**

Further details and application forms can be obtained from:

Dr Peter Ryan e-mail: Peter.Ryan@csiro.au
CSIRO Plant Industry
GPO Box 1600
Canberra ACT 2601
Fax: (02) 6246 5000

About the Plant Nutrition Trust - The Management Committee has included people associated with the Fertiliser Industry Federation of Australia, the Australian Institute of Agricultural Science and Technology, the Australian Society of Soil Science, the Australian Society of Plant Scientists and the Australian Soil and Plant Analysis Council. The funds come from surpluses from International conferences held in Australia and donations from The Sulphur Institute, ASPAC and individuals. **Further donations are welcome.**

Plant Nutrition Trust Awards, 2011

Recipients Reports

Sarah Noack

In October I used my award to attend the ASA-SSSA-CSSA annual meeting in San Antonio, Texas. This was my first international conference and I presented work from my PhD which has been looking at phosphorus (P) forms in crop residues and how these forms influence the fate and availability of residue P in soils. Being able to present provided an opportunity to raise awareness of my research activities and meet researchers in similar research areas. Meeting people in my field also gave me a good indication of where my research sits and the opportunity to think clearly about future experiments within my project. It was also great to see the array of projects going on in relation to P cycling in soils from both agricultural and environmental perspectives.

The ASA, SSSA and CSSA societies also held numerous sessions and forums targeted at graduate students. These sessions encouraged graduate students to network with each other and discuss their thoughts on future careers in research. It was great to mix with students at similar stages in their research careers and discuss some of the challenges ahead.

After the conference I visited Kansas State University Agronomy Department. Here I met with one of our groups collaborators Ganga Hettiarachchi. I was in Kansas for three days and spent most of my time with Ganga's research group looking at some of the work they are doing with regards to P cycling, fertiliser applications and tillage practices. I was also invited to give a presentation on my work as part of their agronomy seminars.

Thank you to the administrators of the award and those involved in the selection process. This was a fantastic career opportunity for me and an experience I will never forget.

Sarah Noack in front of the Henry Gonzalez Convention Centre in San Antonio, Texas.

Dr Chanyarat Paungfoo-Lonhienne

Firstly, I would like to sincerely thank the Plant Nutritional Trust for supporting my attendance to the XVIII International Botanical Congress 2011 (IBC2011) which was held in Melbourne, Australia during 23rd-30th July 2011. IBC is an international meeting of botanists in all scientific fields. Similar to the Olympics games for sport players, IBC is the Olympics for botanists. It is held every six years, with the location rotating between different continents. Therefore, this congress was very important for me as a scientist who is interested in plant nutrition and development. At this meeting, I had an excellent opportunity not only to present my research to the experts in the field but also to gather with leading researchers in the field with whom I would otherwise not meet. The title of my presentation was "Complex organic nutrients as nutrient sources for plants and triggers of root growth".

Apart from giving a presentation and attending the symposia related to my interest, such as "Organic molecules in plant nutrient acquisition: Forest to crop systems; Plant-rhizosphere interactions; and Resource use efficient plants and crop systems", I had been participating in an inspiring program and keynote symposia which expanded my horizon. The plenary session of Prof. Tetsuya Higashiyama in the title of "Live cell analysis of plant fertilisation" was amazing. He showed us an extraordinary movie taken by two-photon microscopy of pollen tubes attraction to the embryo cell. It is very fascinating because we can see clearly how growing pollen tubes are frustrated to keep growing toward the moved-away ovule manipulated by a glass needle. The technology of two-photon microscopy for *in vivo* imaging is a very useful tool for observing interested events in living material. I was thrilled how this technology can undoubtedly reveal this nature's secret of which many scientists tried to understand since 1860s. Certainly, this technology will be fruitful to many studies and possibly mine.

Numerous speakers in the congress emphasised the massive increasing in biodiversity loss because of human activities such as cutting trees, generating pollution etc. Loss of species does not take place only in plants or animals but also in soil microorganisms by synthetic nitrogen fertilisers application in bioproduction systems. Simon McKeon, Australian of the Year 2011, emphasised this problem including food security issue at the open ceremony of the congress and recognised the importance of botanists to solve or prevent these problems. These topics was followed up by, among others, a plenary session on "Food security in a world with biophysical limits" given by Prof. Ken Cassman et al., and a public lecture "The World of Plants" of Prof. Peter Raven. Food security is our immense challenge of 21st century and we have, as botanists, a massive task ahead.

Current researches endeavour to improve biomass production by enhancing photosynthesis. Many studies attempt to identify chance and target where photosynthesis could be maximised. Here, the results from our research fit in completely to this goal, complimenting this research by targeting uptake of organic nutrient by roots. We have identified candidate genes involved in organic N, P uptake which could help biomass production with smaller use of inorganic fertilizers. This will help to enable us to maintain food security and to provide environmental sustainability.
The final Public Discussion involved in research of my interest was moderated by Robyn Williams "Brave new world: can we solve tomorrow's environmental and energy problems by using life itself". There were scientists of two sides, plants and microbes, trying to indicate their important beyond another. It was fantastic to see everyone urged to find a solution for tackling the problem of food security, environmental pollution and climate changes. These dilemmas are all connected and driven from arising of human population and activities. As a current botanist with microbiologist background, I could not agree more to the conclusion of the session that we, scientist, need to work together to solve these tomorrow's problems. In addition, we need to act now and focus on our children, educate them to realise and understand the important of the connection of human-earth-plants-microbes.

Last but not least, attending the congress not only emphasised to me how the knowledge is powerful in taking action but also tangibly encouraged me to develop my skills in speaking in public. Robyn William

is such a good model in this role and personally, listening to him makes me realise how well speaking and presenting is so important. Besides writing scientific papers, oral presentation is another crucial way to deliver our findings and communicate our research. I was fortunate enough for the chance to develop such skill by giving an oral presentation at the IBC2011 while catching up with scientific updates precious for my research, and gathering among those experts.

Natasha Teakle

Summary of activities

The Plant Nutrition Trust Travel award enabled me to travel to Townsville to study salt tolerance and nutritive value of Australian wild rice species growing in Queensland. Seeds of wild rice species *Oryza meridionalis* and *O. australiensis* naturally growing in saline environments were collected from near Townsville in May, 2011. Seeds and soil samples were collected from five different sites that differed in salinity and flooding. *Oryza merdionalis* was found in wetter sites, compared to *O. australiensis*, which was found in drier areas. Other typical species found at the sites were also recorded as an indicator of the salinity of the site. Soil samples were also taken for EC, pH, texture and nutrient analyses.

The collected material was grown under controlled conditions in Sydney to assess the physiological response to salinity and how salinity impacts on the mineral concentrations. The five Townsville lines were grown in comparison to two *Oryza sativa* genotypes, as well as 18 other wild rice accessions previously collected around Australia, to determine variation in salt tolerance and identify lines more tolerant than *O. sativa*. Plants were grown until the 2-3 leaf stage in well-watered pots with loamy/clay soil. Salinity was then imposed in daily 25 mM increments until the final concentration of 75 mM. Saline treatment continued for approximately 21 days, when the *O. sativa* lines were showing signs of salt injury.

These plants were harvested at the end of 2011 and are currently being evaluated for biomass and concentrations of Na^+ and K^+ in the leaves. A wide range of responses to salinity was observed in the wild rice accessions, with some lines showing extreme sensitivity to salinity (dead after the 21 days of salt treatment) and some exhibiting no difference between control and saline treatments. These results demonstrate the large variability found within wild rice for tolerance to salinity and the potential to utilise this germplasm source to improve the salt tolerance of *O. sativa*.

Benefits of award and future collaborations

The collection trip was highly successful with a range of wild rice species collected from varying sites. This provides an excellent future resource to identify wild rice germplasm with superior salt tolerance to cultivated rice (*Oryza sativa*), which is highly sensitive to salinity. This award helped me to develop new skills in germplasm collection and growing wild rice species under controlled conditions.

This travel award also enabled me to develop important collaborations for future work on salt tolerance in wild rice. Dr Lindsay Campbell (University of Sydney) established the connection with Chris Gardiner (James Cook University, Townsville), who helped me locate wild rice in saline sites around Townsville. A/Prof Brian Atwell (Macquarie University) provided glasshouse facilities for growing the plants and also provided other germplasm sources of wild rice species.

The results from this project will provide valuable information on the salt tolerance of Australian wild rices, and thus the potential to use this unique germplasm for improving the salt tolerance of cultivated rice. This will have a great benefit to the rice industry worldwide, as many wetland areas where rice is cultivated are becoming too saline for rice production.

The experiments conducted as part of this award will also be published in an international peer-reviewed journal. I am extremely grateful to the Plant Nutrition Trust for providing funding for the trip to Townsville to collect native wild rice species.

Were you aware that….?

- ***ASPS Website.*** The ASPS website has been thoroughly revamped and is being continuously upgraded.
  - Membership dues can now be paid on line.
  - You can advertise jobs, PhD scholarships, conferences, books by contacting Rob Shepherd via advertise@asps.org.au. To cover the costs involved, the society has introduced a small charge of $34 for members and $74 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.*** This 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 Wiskich 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 (2011 ComBio, Cairns), 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. Members of the Council 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 editor of Phytogen at any time for inclusion in the next issue.

- ***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 $2,500. For more details see the website: http:/www.asps.org.au and take the link to conferences.

- ***Corresponding and Life Memberships.*** Life Membership recognises an outstanding and sustained contribution to the Society by a long-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.asps.org.au and click on "About ASPS" where there is also a list of Life and Corresponding members).