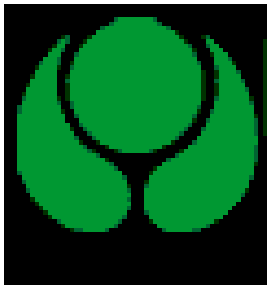

PHYTOGEN

A
NEWSLETTER
FOR
AUSTRALIAN
PLANT SCIENTISTS

Volume 6 Number 3
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PHYTOGEN

Volume 6: Number 3

INSIDE THIS ISSUE

A big thanks to all the scientists who contributed to this issue of Phytogen. The Editors' would like to encourage any member of the society to contact us if they have an article or any news item that they would like to share with Society Members in Phytogen.

Editors' corner

Dear Fellow Society Members,

This is our third issue with the new editorial team, including the respective discipline representatives (from the State or Territory featured in "The State of Affairs"). In this issue, Brent Kaiser, the Discipline Rep from South Australia, edited the "The State of Affairs" section featuring plant science research in South Australia.

Several new features have been introduced in this issue. Steve Tyerman is now President of ASPS and we encourage you to read his "Presidential Message" below. We have established a section on ASPS News which includes items on ASPS activities and services to members. We are happy to celebrate the achievements of the winners of the student Poster Prizes at ComBio by publishing a summary of their findings. We also have introduced a continuing item on Intellectual Property as it relates to the Plant Sciences entitled "IP Roots and Branches". In this issue Eloise Foo has been the contributing editor to the "Twigs & Branches" section. We welcome further contributing editors to this section to ensure diversity in reporting Plant Science. In this issue we feature in "From our Seed Banks" reports on national and international meetings attended by members. We welcome reports from members of meetings relevant to plant science (both local and international); so please send reports to Andy Netting (anetting@unsw.edu.au) who is co-ordinating "From our Seed Banks".

We would also like to alert you to the "Did you know" section. This section serves as a means to keep members abreast of developments that the society undertakes and also to alert members to interesting items of news regarding our members and plant science in general. Please keep the items coming.

Helen Irving and Andy Netting

President's Message

Welcome to the ASPS if you are a new member, and if you are a continuing member of the society, I am glad that you take the time to read Phytogen. I would like to introduce myself to those who do not know me; I am the Professor of Viticulture at the University of Adelaide, having moved from Flinders University in 2001 after 18 enjoyable years in the School of Biology with my colleagues in plants Kathy Soole, Peter Anderson, Kathy Schuller, Alex Hope, and Geoff and Nele Findlay. At Flinders I established my research in membrane transport of solutes and water, focusing on ion channels and water channels (aquaporins). I also dabbled in ecophysiology in relation to salt tolerant variants of *Eucalyptus largiflorens*, which was discovered on the salt degraded floodplains of the Chowilla anabranch. Research on quandong was also an interesting diversion, thanks to supervision of Beth Loveys during her PhD. Most of my teaching at Flinders was in ecophysiology of plants and I ran a 3rd year course by that name for about 14 years. The move to viticulture might seem to some as a rather adventurous side-step. Although I am still on a steep learning curve, I have not looked

back with many new opportunities arising in research funding supported by a forward looking industry. Some of my former Flinders students have also burst on to the viticulture scene and are doing very nicely in industry and in research. I have been made welcome by the wine industry and a vibrant research community, and here there are many overlaps with my previous associations. My research continues on ion channels and aquaporins and as before with an eye to how they work in the function of the whole plant, only now it is with a different model plant most of the time, the grape vine.

My association with the Society began when I completed Honours in 1976. I joined the society (then ASPP) and I started going to meetings. I remember clearly one of my first meetings (in Brisbane) when Richard Storey and I travelled from Sydney in his Datsun 1600 with a couple of surfboards attached. At the meeting I asked Geoff Findlay a rather naïve question on how I would go about measuring the growth of a seagrass that I was working on (*Halophila ovalis*). I got a rather typical non-nonsense straight forward answer from him. Little did I know then that I would have a long and fruitful association with Geoff when I later went to Flinders. I remember always coming away from the meetings with fresh ideas and a better understanding of areas outside of my own. This and the meeting of people with the same passion for trying to understand how plants work, was probably the most important driver for me to continue on my journey with plants. I would like the Society today to ensure that we continue providing this drive and enthusiasm in plant sciences for our younger members.

The meetings are one of the most important parts of the Societies activities. They are about getting ideas, forming collaborations, being mentored and mentoring, and getting support from our friends. We now combine in a greater association at COMBIO, because modern biology shares no boundaries across the traditional disciplines. It is amazing how many leads one can get in research by attending some of the human/animal biology seminars. Even so, a balance must be struck and I intend to find the best way of maintaining the COMBIO association while still allowing the Society to represent the diversity of interests of its members. To this end we should encourage associated meetings, and perhaps state based meetings that have clear benefit for our postgraduate students and early career researchers.

Finally I would like to welcome the new members of council and thank those that are retiring and who have given as much as they could to the Society. I would particularly like to thank Kathy Soole and Rana Munns who as treasurer and secretary have left the society with both a healthy bank balance and many new members. Hans Lambers' presidency has demonstrated how we can reach across diverse areas of interest from molecular to ecophysiology and bring these closer, I hope to continue strongly in this way.

Cheers
Steve Tyerman

ASPS News

This is to draw your attention to a feast of new information that recently was uploaded onto the ASPS website (http://www.plantsci.org.au). Could I particularly draw your attention to;

1. **Council Members for 2004-2005**. Steve Tyerman has assumed the mantle of ASPS President from Hans Lambers. Peter Ryan has taken over the position of Honorary Treasurer as Kathy Soole has completed her tenure in this position. There also have been changes to the composition of the Discipline Representatives. New members are welcomed and those departing thanked for their valuable contributions.

2. **Minutes of the Annual General Meeting**. Please note the Treasurer's Report indicating the healthy state of the ASPS finances as well as reports from Plants in Action and Functional Plant Biology. Much of the AGM was devoted to discussing how the plant sciences profile in the 2005 Adelaide ComBio can be maintained and built on from the excellent platform generated at the Perth ComBio.

3. **Corresponding/Life Members**. These members are now listed together with criteria for their selection. ASPS members are encouraged to nominate candidates for these esteemed positions.

4. **ASPS Support for Workshops and Conferences**. As one initiative to promote plant science within the national research community, ASPS supports members running workshops and conferences by offering seed funds. Guidelines and a downloadable application form are available on the website.

5. **RN Robertson Funds to Support Early Career Researchers**. A number of initiatives are underway to build the RN Robertson Fund to a level that will support the proposed activity in perpetuity. In order to make the opportunity of donating to this fund more assessable to members, the 2005 Membership Renewal form has been re-designed to accommodate this optional opportunity.

6. **Goldacre and Teaching Awards**. Nominations for these prestigious awards will close on April 15, 2005. Please give thought to nominating a deserving recipient.

7. **2005 Membership Renewal**. Deadline for renewal of membership is set at March 31, 2005.

8. **FASTS**. This is an extremely active organization working on your behalf. To assist members assessing the prodigious output of information by the Federation, a link has been made to the FASTS website from the "About ASPS" page.

9. **ASPS Promotional Material**. An ASPS Flier and an ASPS Poster as downloadable PDF files are available on the website for use by any ASPS member to promote the Society within their institution or elsewhere.

Items 1 and 2 can be accessed using the button labelled , the remaining items can be accessed from the Web page entitled "About ASPS".

In the meantime, productive researching.

John Patrick
Honorary Secretary

DISCIPLINE PERSPECTIVES

Cell Biology

The Australian Plant and Fungal Cell Development Group Kioloa meeting 2004
11th Annual meeting Kioloa NSW

What is now affectionately known as the "ABCD… group" by its members has been holding small informal meetings of between 20 and 30 scientists for about 11 years.
See: http://bioscience.babs.unsw.edu.au/fungus/apfcdg/

We met again this year at ANU's research station at Kioloa, which is about 30 km drive North of Bateman's Bay. The conference was organised by Dr Leila Blackman (ANU) and generously sponsored by Beckman-Coulter to the tune of $500 which enabled students to attend for free. About 20 people came to the meeting with 16 giving informal 15 min talks. There was plenty of time for swimming at the nearby beach, watching Dolphins play or just sitting and chatting in a relaxed atmosphere.

Brief summaries of some of the talks follow. We hope to put the remainder on the web site soon.

David Mills, (RSBS, ANU –visiting fellow from Ben-Gurion University, Beer-Sheva, Israel). "Any specificity between transformed (hairy roots) and ectomycorrhiza fungus in vitro?"
In nature, the ectomycorrhiza fungus *Tuber melanosporum* (black truffle) is in symbiosis with roots of *Cistus incanus*. The objectives of the presented research were to test the specificity of the tuber with different hairy roots (*Agrobacterium rhizogenese* transformed roots) including cistus hairy roots and to identify signals that are involved in the symbiosis. It was found that only cistus hairy roots stimulated growth of the tuber.

David Collings (ANU) "Lipotubuloids I have known"
Dave talked about organellar complexes (lipotubuloids) in petal epidermal cells of the bulb *Ornithogalum umbellatum*, (Sleepy Dick). Lipotubuloids contain lipid droplets that are intimately associated with both microtubules and peroxisomes. Emeritus Professor Brian Gunning (ANU) observed these complexes over 30 years ago using Electron Microscopy and is now collaborating with Dave who is using fluorescence microscopy techniques to reveal the lipotubuloid's secrets.
One burning question is can you get cream for them?

Sandy Tuszynska (UNSW) "Effects of metal sulphates on organelles and microtubules of the ectomycorrhizal fungus Paxillus involutus from metal rich soil"
Basically tubular morphology of vacuoles and mitochondria is disrupted and nickel causes microtubule array disruption. Effects on organelles are recoverable.

Leila Blackman (ANU) "Proteomic identification of plasmodesmatal proteins"
Leila presented work of a PhD student, Christine Faulkner (Sydney Uni) that she co-supervises with Robyn Overall (Sydney Uni). This talk focused on the identification of proteins involved in cell-to-cell communication by proteomic-based techniques using the giant-cell alga, *Chara corallina*. Extracts made from walls containing plasmodesmata, the channel for cell-to-cell communication between adjacent cells, were compared to extracts from walls without plasmodesmata using two-dimensional electrophoresis. A number of proteins were identified using mass spectrometry, some of which had previously been identified by other research groups while others were unknowns. In addition, the actin filament stabilisation protein, tropomyosin, was found to immunolocalise to plasmodesmata.

John Harper

Environmental & Ecophysiology

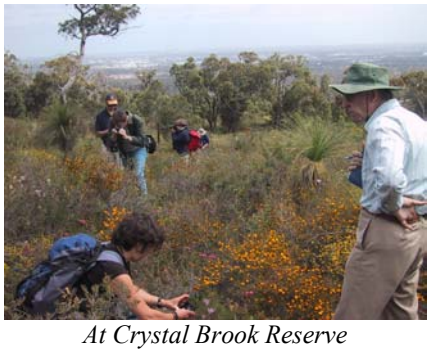
Ecophysiology Field Day

The day after Combio, twenty-five ecophysiologists went out into the bush near Perth. It was a glorious day and many plants were in flower. Byron Lamont (Curtin University) showed us around and told us some of those wonderful stories of adaptation that reminded us why we'd become plant scientists in the first place (see picture).

One such species is *Hakea trifurcata.* It is a heterophyllous shrub, producing leafy, highly productive leaves early in the growing season when water is available, and then spiny needles as summer approaches. Not only are the needles better able to cope with the hot, dry conditions themselves but they also serve to shade the broader leaves, enabling them to continue to contribute to plant growth. If that is not enough, studies have shown that the curvaceous broad leaves also function to deter herbivores from feeding on the seeds by mimicking the follicles. (Unlike other hakeas, the follicles are soft.) Black cockatoos feeding on the bushes become frustrated with the predominance of apparently empty follicles and quickly discontinue feeding.

Donkey orchid at Yule Brook Reserve – photo Matt Denton

There were many other wonders at Crystal Brook Reserve on the Darling Scarp (heath, wandoo and jarrah woodlands) and Yule Brook Reserve (banksia woodland and swamp) — succession, zonation, plants that produced different coloured flowers over a season, weird roots of every description (proteoid, nodules, dorsiform) and all kinds of orchids. Everything had a story.



At Crystal Brook Reserve – photo Ros Gleadow

We also visited Grasstrees Australia, where Dani Mutch explained their strategies for rescuing significant plants such as *Xanthorrea*, *Macrozamia riedlei, Kingia* and the parasitic West Australian Christmas tree *(Nuytsia floribunda)* from land earmarked for development, growing them up and reselling them.

At Grasstrees Australia – photo Ros Gleadow

Thanks to Matt Denton and Pieter Poot for organizing the bus and meals, and especially to Byron for making it live.

In the light of discussions at the ASPS annual meeting, the ecophysiologists will again hold a 1-2 day satellite meeting associated with Combio next year, probably more along the lines of Ecofizz2003. There are also plans for a separate workshop in November 2005. If you would like to be on the mailing list for either of these, or have any suggestions for next year's Combio, please contact Ros Gleadow at her new email address rgleadow@bigpond.net.au.

Ros Gleadow

Plant Microbe Interactions

2nd Australian Model Legume Workshop; Application to Crop and Pasture Improvement Rottnest Island, Perth, Western Australia 5th-8th April 2005

This workshop has sessions on comparative genomics, bioinformatics, symbioses and biotic/abiotic stresses of model legumes, in particular of *Medicago truncatula* and *Lotus japonicus*, two model legumes studied extensively for a number of symbiotic and pathogenic plant-microbe interactions. The conference features several high profile International and Australian speakers, and will take place on beautiful Rottnest Island, near Perth.

The Key Dates are:

Early Bird Registration	1st December 2004
Final Registration	15th January 2005
Abstract Deadline	28th February 2005

More Information can be found at http://www.plantsci.org.au/modellegumeworkshopflyer1.doc

The **15th Biennial Australasian Plant Pathology Society Conference** will take place in **Geelong, Victoria in September 2005.**

The theme of the conference is 'Innovations for sustainable plant health'. This theme will allow us to focus on the key issues, review past lessons and explore the application of new technologies to ensure we can maintain and improve plant health, now and in the future. In addition to invited plenary and keynote speakers who will give presentations addressing this theme, we invite you to give oral and poster presentations of recent scientific work in the field of plant pathology.

Important dates are:

Expression of interest to attend the conference:	5 November 2004
Closing Date for Submission of Abstracts:	27 May 2005
Closing Date for Early Conference Registration:	27 May 2005

More information can be found at: www.deakin.edu.au/events/APPS2005

Legumes biotechnology gets the nod for plant developmental biology, genomics as related to environmental sustainability and human health.

The ARC Centre of Excellence for Integrative Legume Research (CILR) has been established under the Federal Government's 'Backing Australia's Ability' scientific initiatives. It is one of only 8 such centres and the only one dealing with plant biology. Significant support also comes from the partner universities as well as state governments (e.g., Queensland Smart State Fund). The centre is a research partnership of four leading Australian universities, namely the University of Queensland, the Australian National University, the University of Melbourne and the University of Newcastle. The centre combines 11 chief investigators who have a common background in research and teaching. Excellent opportunities exist for post-graduate research studies at each of the CILR nodes.

The CILR will drive further development of the genomics and phenomics of legumes. It has the critical mass of human, intellectual and infrastructure resources to function as a world-class research centre. It focuses on research that will provide critical insights into mechanisms of organ differentiation and intercellular communication, utilising comparative genomics on the model legumes *Lotus japonicus* and *Medicago truncatula*, and research in the larger crop legumes soybean and pea. For further details consult the website (www.cilr.uq.edu.au). The Centre will host the International Conference on Legume Genomics and Genetics in Brisbane (9.-12th April 2006; **http://www.iclgg3.org/**).

Ulrike Mathesius

Focusing on one state's research per edition

This edition:

South Australia

Collated and edited by Brent Kaiser
(the discipline representative resident in South Australia)

Introduction

Welcome to the feature article highlighting some of the research in plant science by ASPS members in South Australia. South Australia continues to be a strong performer in plant science research in Australia and internationally and continues to live up to its past achievements and commitment to plant science research and teaching. Since the last South Australian Phytogen expose, the state has experienced a real growth in plant science activity mainly due to the establishment of the Australian Centre for Plant Functional Genomics in late 2002 (see below). The centre led by South Australians Prof. Peter Langridge, and Prof. Geoff Fincher (The University of Adelaide) has dramatically transformed plant science at the Waite campus where we have witnessed the construction of a state of the art plant science complex (**The Plant Genomics Centre)** but more importantly a large number of new Australian and international plant scientists are now calling Adelaide home. As a research group, South Australian plant scientist's benefit strongly from the effective collaboration between University (Adelaide, Flinders), State (South Australian Research Development Institute -SARDI, Primary Industries and Resources South Australia - PIRSA), and Federal (CSIRO Plant Industry) partners. Much of this synergy occurs at the Waite campus where co-location of the UA, CSIRO, SARDI, and PIRSA allow effective sharing of resources, infrastructure and an environment that supports scientific cooperation and intellectual exchange. There are also strong links between other plant scientists at the Flinders University of South Australia as well as members of the society working at the North Terrace campus of the University of Adelaide.

Some members of the society have graciously offered their time to prepare a few paragraphs explaining what their groups are up to. I'm sure all of the contributors would welcome hearing from you if you want to learn more about their projects, available facilities or the potential for collaborative science.

Brent Kaiser

Brent N. Kaiser

I have been in Adelaide for just under two years where I'm presently a Lecturer in Viticultural Science at the University of Adelaide. Prior to coming to Adelaide I completed my PhD with Prof. David A. Day at the ANU (1999) and then worked as a postdoctoral fellow in Nice France (University of Nice), Vancouver Canada (University of British Columbia), and Canberra ACT (Australian National University). Since coming to Adelaide, I've continued with similar research streams initiated in graduate school in both Canada and Australia. This research primarily involves the study of plant membrane transport proteins notably those involved in inorganic nitrogen transport as well as the transport of trace elements Fe (II) and Molybdenum. Our model systems we use in the lab range from yeast cells, soybean nodules and the peribacteroid membrane encircling the nitrogen-fixing bacteroids, *Arabidopsis thaliana* and *Vitis vinifera* wine cultivars

Being relatively new to the state, I have been pleasantly impressed by the synergies amongst the researchers and the opportunities that exist for excellence in research and potential for innovative collaborations. I've outlined some of the projects we are pursuing in the lab a number of which have arisen solely from being located at the Waite campus.

Membrane Transport

We are currently pursuing a number of research streams in the lab focussing on plant membrane transport. The first stream involves a joint ARC funded collaboration with **Prof. Anthony Glass** at the University of British Columbia investigating the *in planta* role of the high-affinity ammonium transport family AMT. This work is being led by **Dr. Sunita Ramesh** who is using reverse genetics to study loss of AMT function on net ammonium transport into hydroponically grown Arabidopsis plants. We are using a large collection of AMT mutant plants to dissect which protein is the primary ammonium transporter involved in ammonium uptake and then how to improve upon its existing performance. The second stream is a continuation of research I completed in my PhD where we are investigating the types of transport proteins located on the peribacteroid membrane of soybean nodules. This is collaborative ARC funded project with **Prof. David A. Day (UWA), Prof. Steve Tyerman (UA), and Dr. Martha Ludwig (UWA)**. In my group, **Patrick Loughlin** (PhD candidate) is characterising the role of the peribacteroid membrane protein GmSAT1 as well as developing novel infected cell cDNA library collections for functional screens of expressed genes in infected nodule cells. The third stream is Viticulture orientated but applicable to most plant systems. **Kate Gridley** (PhD candidate) is investigating how molybdenum is transported into plants. Our interest in molybdenum stems from an unique phenotype present in *V. vinifera* cv. Merlot, which suffers from poor growth as a young rootling and poor fruit development (Millerandage) where both of these phenotypes can be reversed by foliar molybdenum sprays or grafting to North American hybrid rootstocks. In keeping with the labs interest in nitrogen metabolism, we are also exploring the types of nitrogen transport systems, the method of nitrogen assimilation and how and when nitrogen is redistributed in grapevines. This project is new for us and initially is being conducted on an annual basis by a rotation of Honours students (**Joanne Nagaire Brady, Juliet Jansen-Henderson, Elise Heyes**) working in the lab.

New Collaborations

I've recently joined forces with **Prof. Margaret Sedgely** (UNE) and **Dr. Chris Ford** (UA) to introduce self-fertility into commercially grown almond cultivars and to genetically characterise the mechanisms controlling bitter flavour in almond. These two projects are both ARC-linkage grants funded in association with the Almond Board of Australia. The linkage grant to introduce self-fertility into almond is led by **Dr. Jenny Guerin** and **Dr. Tricia Franks** while **Kat Malone** (PhD candidate) is characterising the functionality of a novel self-fertile allele found in select *Prunus dulcis* cultivars and **Esmaeil Seifi** (PhD Candidate) unravelling the method of self incompatibility in Olive. I have found it quite refreshing embarking on a completely different research field from which I'm most familiar with

and have enjoyed these new collaborations immensely. Lastly, **Prof. Mark Tester** and myself have just initiated a new collaborative project where we are co-supervising an ACPFG sponsored PhD student (**Scott Carter**) on a project to investigate the molecular control of non-selective cation channel activity in plants and in yeast. Its been great having Mark Tester next door in the ACPFG / Plant Genomics centre to bounce ideas off and to get this challenging project off the ground.

My research group is located in the level 2 of the Plant Research Centre at the Waite Campus. If visiting the Waite, come by, my door is always open.

Kaiser Lab. From left to right, Kat Malone, Kate Gridley, Brent Kaiser, Sunita Ramesh, Patrick Loughlin, Jenny Guerin, Viviane Becart, Esmaeil Seifi, Megan Shelden, and Scott Carter.

Mark Tester

I am pleased to have the opportunity to return from Cambridge for my third 'stretch' at the University of Adelaide, this time embedded in the new Australian Centre for Plant Functional Genomics, at the Waite campus (see http://www.acpg.com.au). The aim of this Centre is to identify genes in wheat and barley that confer tolerance to abiotic stress, and then to use this knowledge to improve the ability of these important crops to grow in the 'challenging' conditions of Australia - where it always seems to be too hot, too cold, too wet, too dry, or there are too many or not enough solutes in the soil.

My group's work focuses on salinity tolerance and the role of membrane transport processes in minimizing the accumulation of Na^+ in the shoot (as described in Tester & Davenport, 2003: *Ann. Bot.* 91, 503-27; and on my website, at http://plantscience.acpfg.com.au/). Activity has been concentrated mainly on the mechanisms of Na^+ entry into plants, and the nonselective cation channels that appear to be the primary pathway for this entry. More recently, we have been looking increasingly at the mechanisms and control of allocation of Na^+ from the root to the shoot, and the significance of root cell-type specific processes in the control of Na^+ accumulation in the shoot.

Whilst focusing on the control of Na^+ accumulation, I realized that the principles underlying this work on Na^+ in fact apply to the accumulation of all plant nutrients. From this realisation emerged a program that Roger Leigh (in Cambridge) and I half-jokingly termed 'nutriomics'. Since arriving in Adelaide, Steve Tyerman and I have put together a website, the ARC-funded 'Australian Plant Nutriomics Network', which links Australian scientists investigating aspects of the plant nutriome - the summation of processes that deliver nutrients and water from soil to plants. So far, this network has brought

together 61 Australian groups from 15 institutions and information on research activities is collated at http://www.acpfg.com.au/nutriomics/index.htm. On this site, research activity is organised by research groups, biological areas and technical skills. Thus it provides a useful means for researchers to obtain information at various levels on plant nutriomics, making the site more than simply an audit of Australian nutriome research. Do visit the site - if you see mistakes and omissions, please get in touch.

Our work on the 'nutriome' has been given a boost with an ARC Discovery grant, which will allow us to generate lines of Arabidopsis with cell-specific activation of specific and random genes, and to measure the effects of these manipulations on inorganic solute accumulation in the shoot (using ICP-MS). We are building on this work in Arabidopsis by generating enhancer trap lines of rice, to allow cell-specific gene activation in a wide range of cell types – our catalogue illustrating several thousand of these lines can be viewed at http://plantscience.acpfg.com.au/project/detail/36. Please browse it, and consider how you might like to use these lines.

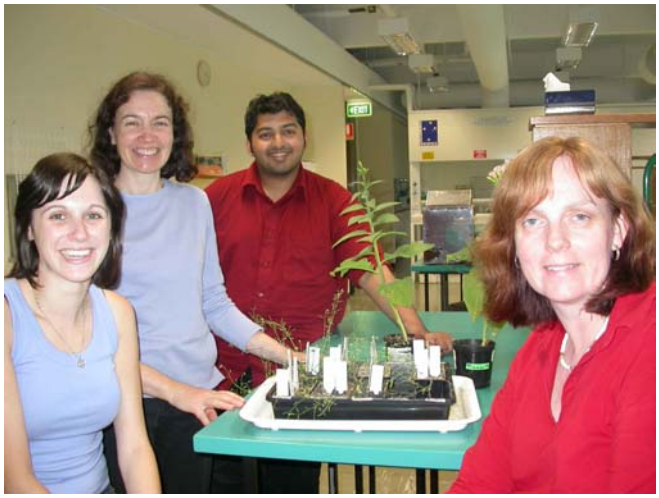
Joining the Centre has enabled me to collaborate with excellent geneticists, notably Peter Langridge and Nick Collins, and so we are adding a forward genetics dimension to our research. This is a new and exciting opportunity made possible by my move to Australia. We are now investing significant effort in the use of existing mapping populations and the development of new populations, the aim being to positionally clone genes responsible for Na^+ exclusion in cereals.

Moving to the Waite campus has proved to be enjoyable, stimulating and refreshing. In these days where the 'big science' approach is now proving increasingly successful in biology, the remarkable number of people on this (beautiful!) site provides a critical mass for high quality research. Although it is invidious to name individuals, I would nevertheless like to take this opportunity to thank a few colleagues at the Waite - Peter Langridge, Geoff Fincher, Steve Tyerman, Brent Kaiser, and Sally and Andrew Smith. All these people have made me and my family so welcome, and they continue to be excellent colleagues and collaborators.

Tester Lab. From left to right, Robin Hosking, Fran Tracy, Emily Grace, Stuart Roy, Deepa Jha, Alex Johnson, Marilyn Henderson, Mark Tester, Caitlin Byrt, Darren Plett, Damian Drew, Yuri Shavrukov and Ali Izanloo.

Kathleen Soole

Plant research in my lab is focussed around the control of respiration and its role in plant growth. In particular we are interested in what the non-phosphorylating or the non ATP-producing pathway of respiration plays and our focus is on the NAD(P)H dehydrogenases. We have been generating null mutants of the NAD(P)H dehydrogenase enzymes in *Arabidopsis* using a RNAi strategy with an aim to link the putative NAD(P)H dehydrogenase gene(s) with a specific protein and activity in mitochondria isolated from leaf and root material. Vanessa Melino and Vivek Vijayraghavan are both students who have been designing the RNAi constructs and generating transgenic plants where different NAD(P)H dehydrogenase genes have been down-regulated. Lidia Mischis has been providing critical technical support for the project. For 2005, we have been successful in attracting ARC funding for a project where we will use the mutants to assess their impact on the whole plant metabolome, using metabolomics technology developed at the Max-Planck Institute in Germany. Biosynthetic reactions for other plant metabolites are reliant on the intermediates of the respiratory pathway. Thus manipulation of these pathways may impact on secondary metabolite production in plants which will have implications in biotechnology as well as for stress response in plants. The stresses we are currently interested in are salinity and phosphate limitation.



Soole Lab. From left to right Vanessa Melino, Lidia Mischis, Vivek Vijayraghavan and Kathleen Soole.

Amanda Able

The plant physiology and pathology laboratory within the discipline of Plant and Pest Science at the University of Adelaide has 15 members who are focusing on plant-microbe interactions and postharvest physiology. Our main research focuses on the role that reactive oxygen species and antioxidant mechanisms play in the defence response of barley to the necrotrophic pathogens *Pyrenophora teres* and *Rhynchosporium secalis*. This work is funded by the Grains Research and Development Corporation (GRDC) and the Molecular Plant Breeding CRC (MPBCRC) and will hopefully allow us to develop new varieties with durable resistance to these pathogens. The physiological disorder of barley grain called black point also seems to involve reactive oxygen species and wounding during grain fill. Our GRDC-funded research into the mechanisms of barley blackpoint formation has shown that the type of peroxidase present in the grain during grain fill (if high humidity occurs) is the main determinant. We are currently using a proteomics approach to help determine what controls these peroxidases in the appropriate environmental conditions (funded by MPBCRC). Moving away from barley, we also have a major ARC project looking at the interaction between nutrition, genotype and environment on the formation of powdery mildew and Botrytis. Our research thus far has shown that calcium application has a major impact on the prevention of Botrytis formation postharvest and silicon seems to prevent powdery mildew infection through enhancement of deposition of 'papillae'. In the postharvest field, we have students researching the physiology of pepper ripening and the effects of 1-methylcyclopropene (an ethylene inhibitor) on the shelf-life and physiology of bananas and strawberries.

Steve Tyerman

The research conducted in the Tyerman lab focuses on solute and water transport in plants. Under this broad theme there are the following projects; the nature of non-selective solute transport through aquaporins in biotrophic interfaces (Dr Christa Niemietz and Wendy Sullivan), anion channels in roots responsible for organic anion release (Dr Wen-Hao Zhang and Wendy Sullivan), the mechanism of Cl^- and NO_3^- uptake by grapevine roots under salinity (Nasser Abaspour), grapevine root hydraulics and the role of aquaporins (Rebecca Vandeleur), grapevine shoot hydraulics and the role of aquaporins in refilling of cavitated xylem vessels (Megan Shelden), and the hydraulics of grapevine berries in relation to the phenomenon of berry shrinkage at advanced stages of ripening (Jo Tillbrook). The lab is well equipped for a range of transport studies and scientists and students who wish to use these techniques in their research are welcome to visit and use the facilities. There is equipment for vesicle transport studies (stopped flow spectrofluorimeters and particle sizer), electrophysiology (patch-clamp rigs, voltage clamp of oocytes, MIFE^{tm}), pressure probes for single cells and roots, and hydraulic conductance flow meters for investigating the hydraulics of whole root systems and shoots. We also have a Xenopus frog colony and routinely harvest oocytes for functional studies of transport protein genes. These are mostly used presently for the expression of various aquaporin genes including NOD26, and PIPs and TIPs cloned from grapevine and legumes. However, the lab would also welcome the opportunity to collaborate on the functional characterisation of other transport proteins from plants. The lab was also the first to combine the non-invasive ion flux technique (MIFE^{tm}) with patch-clamping and a recent collaboration

with Dr Matthew Gilliham from Mark Tester's Cambridge lab has demonstrated the power of characterising ion channel selectivity in physiological solutions with this combined technique. There is a strong emphasis in the lab for integrating the molecular function of ion and water transport to whole plant physiology, and as such we have the ability to measure various functions scaled up from the membrane to the cell to the whole organ level. Existing collaborations occur with Professor John Patrick, Professor David Day and with Professor Wen-Hao Zhang who has recently taken a professorial position with the Institute of Botany in the Chinese Academy of Sciences.

Recent publications from the group include:

Tyerman S.D., Tilbrook J., Pardo C., Kotula L., Sullivan W., Steudle E. (2004) Direct measurement of hydraulic properties in developing berries of *Vitis vinifera* L. cv Shiraz and Chardonnay. Australian Journal of Grape and Wine Research 10, 170-181.

Vandeleur R, Niemietz C, Tyerman S.D. (2005) Roles of aquaporins in root responses to irrigation. Plant and soil (in press)

Zhang W-H, Ryan P.R., Tyerman S.D. (2004) Citrate-permeable channels in the plasma membrane of cluster roots from white lupin. Plant Physiology 136, 3771-3783.

Zhang W-H, Walker N.A., Patrick J.W., Tyerman S.D. (2004) Pulsing Cl- channels in coat cells of developing bean seeds linked to hypo-osmotic turgor regulation. J. Exp. Bot. 55, 993-1001.

Zhang W-H, Walker N.A., Patrick J.W., Tyerman S.D. (2004) Calcium-dependent K current in plasma membranes of dermal cells of developing bean cotyledons. Plant, Cell and Environment 27, 251-262.

Tyerman Lab. From left to right Helen Bramley, Rebecca Vandeleur, Wendy Sullivan, Steve Tyerman, and Christa Niemietz.

Functional Plant Biology

December Update 2004

ComBio Review

FPB once again had a successful time at ComBio. Judi and I enjoyed meeting so many of you, and we appreciate the feedback that we received about our new electronic delivery format, the scope of FPB, and some possible future directions. I was also pleased to be able to attend part of the APSP Executive Council meeting and look forward to strengthening the links between the Society and the Journal. Thank you very much to those who participated in the FPB survey, your comments have been very helpful. The winner of the book prize, drawn by Sharon Robinson, was Harvey Millar.

This year we heard two very impressive Goldacre Lectures, the first from last year's winner, Harvey Millar, and the second from Steve Swain, the winner of the award for 2004. I was very happy to join with the incoming ASPS President, Steve Tyerman, to present Steve with his medal and a cheque. A paper based on Harvey's presentation was published in FPB in June, and we hope to publish a paper based on Steve's lecture early next year.

FPB Best Paper Prize

Functional Plant Biology, together with the Australian Society for Plant Scientists, is pleased to offer an award for the best paper published by an early-career scientist in the Journal in each calendar year. The winner of the award will be invited to present an oral paper at the ComBio conference in the year of the award and registration will be funded by the ASPS. The award also carries a prize of a one-year print + online subscription to FPB and a certificate presented by the president of the ASPS.

To be eligible for the prize the first author must be:

1. A member of the ASPS
2. A PhD candidate or no more than 10 years post-PhD

Reviewers will be asked to nominate whether a manuscript is suitable for consideration for the prize. Papers nominated for the award will be judged by the Editorial Advisory Committee of the Journal, along with the Council of the ASPS. The winner of the award will be announced in a mid-year issue of the Journal.

2004 in review

This year has been one of substantial change for the Journal, which has seen a temporary change in editorial staff (Jennifer returns as Managing Editor in February 2005), a change in delivery of our online content and preparations for a move to a fully integrated online submission and review system. These changes have made my year as Acting Managing Editor challenging and exciting. I would like to thank the ASPS and its members for your ongoing support of FPB; your advocacy for the Journal and your excellent submissions are greatly appreciated. I would also like to record my thanks to Judi Walters, our fabulous Production Editor, who has ensured that FPB has continued to be published on time, and has also managed a smooth transition to full-text HTML online delivery.

I wish you all the best for the Festive Season and a productive year in 2005.

Amanda Ellery
Acting Managing Editor, FPB

From Our Seed Banks

Meeting reports provided by members from around the country

We welcome meeting reports from all local and international meetings. Please contact Andy Netting (co-ordinating editor) at anetting@unsw.edu.au for further details.

IPGSA Conference, 2004.

18th International Conference on Plant Growth Substances, Canberra

There is a tide in the affairs of men
Which taken at the flood, leads to fortune…

No doubt many readers of *Phytogen* will consider that the use of this quote from Shakespeare's *Julius Caesar* is pretentious. Yet, I feel that plant science is coming of age in the sense that a detailed understanding of how plants 'work' is almost within reach. So, was the tide taken at the flood?

Certainly things started off well when the Silver Medallists, Jake Jacobsen and Russel Jones, spoke on how the gibberellin that is released by the embryo stimulates the aleurone cells to synthesise and release α-amylase and other hydrolytic enzymes so that reserves in the endosperm can be mobilised. Russel's talk was focussed on the subcellular structure of aleurone cells and the variety of vacuoles that they contain and how the oil-containing oleosomes utilize β-oxidation to provide energy and C_2 units for gluconeogenesis. A by-product of this reaction is H_2O_2 and its accumulation apparently leads to aleurone cell death. So far, this was encouraging in that in my view an appreciation of metabolism is crucial to understanding growth and a plant's response to environmental changes and yet, in these days of gene sequencing and transcription factors, metabolism is rarely mentioned. However, it was mentioned the following morning in a talk entitled 'Genetic Analysis of Auxin Regulation'. Among the metabolites mentioned was indole butyric acid which appears to be particularly involved in lateral root formation and embryogenesis. It is taken up by peroxisomes and converted to IAA by β-oxidation, again with the liberation of H_2O_2. As H_2O_2 opens Ca^{2+} channels in guard cells it is now a strong possibility that it is a universal plant signalling molecule.

But it was in the next plenary presented by Shinjiro Yamaguchi that I felt that we had, at least, assembled all the necessary tools to take the tide at the flood. This group at RIKEN has shown, using a combination of old-fashioned techniques – namely the incorporation of [^{13}C]-labelled intermediates – with carefully selected mutants, that carotenoids, phytol, ABA and the GA's are made by the MEP (methylerythritol phosphate) pathway in plastids and that sterols, ubiquinone and the brassinosteroids are synthesised via the cytosolic MVA (mevalonate) pathway. Intriguingly, *trans*-zeatin is synthesised by the MEP pathway and *cis*-zeatin by the MVA route: apparently this is related to the much higher activity of *trans*-zeatin compared to *cis*-zeatin. So, here, at last, is metabolism at centre stage where it surely belongs because it describes how plants synthesise and mobilise energy rich compounds, provide substrates for growth and reproduction and the energy to move ions from one compartment to another to control osmotic pressure and pH.

So I returned after morning tea with heightened expectations and we certainly heard some interesting talks on brassinosteroids, ABA and GA biosynthesis but the moment seemed to have past. And for me that latter feeling continued in the following morning in that the talks were about the minutiae of protein degradation in the regulation of signal transduction. No doubt an important topic but not ceasing the moment! Yet this is the way of science: the minutiae are examined and then reassembled so that more of the whole is understood. So perhaps the flood has not passed us by but is still approaching?

This was indeed the feeling I had the next morning when Rana Munns spoke, in place of Dorothea Bartels, on the control of leaf growth during drought and salinity and showed that we are close to dissecting the roles of plant water relations and of hormones in controlling this parameter. Mark Tester then emphasised the role of the endodermis in excluding Na^+ so that a major portion of it is exported to, and then probably stored in, the vacuoles of cortical cells. However, exposure to salt does rapidly inhibit cell expansion in the shoot perhaps due to ABA that is produced as a result of the exclusion of salt be the endodermis. On reaching cells in the shoot this ABA stimulates the export of K^+ and anions so that water follows to control the water potential of the cells and apoplast. Finally, in this session, Julian Schroeder spoke on guard cell signal transduction and made the daunting observation that there are ten NADPH oxidases involved in the reactive oxygen species activation of guard cell Ca^{2+} channels and thirty four Ca^{2+}-dependent protein kinases. Although his group and others are starting to get to grips with these complexities it is clear that the flood is still approaching and that the next two lines from Shakespeare are not upon us:

Omitted, all the voyage of their life
Is bound in shallows and in miseries…

Andy Netting
University of New South Wales

ISPA Conference

8th Conference of the International Society for Plant Anaerobiosis

The 8th Conference of the International Society for Plant Anaerobiosis (ISPA) was held in Perth, September 20-24, 2004. The Conference was held on the UWA Campus, and included a 'field tour' via boat up the Swan River, passing constructed wetlands, natural marshes, and riparian vegetation, on route to the Swan Valley for the Conference Dinner.

The ISPA has a membership of scientists interested in the mechanisms of acclimation and adaptation of plants to poorly aerated environments. Waterlogging and submergence are major environmental stresses for plants in many ecosystems; these conditions define natural wetlands, underpin much rice production, and can restrict yields in most cropping systems. Plants studied, at various levels (molecular biology to ecology), include those inhabiting marine, aquatic, salt marsh, wetland, and terrestrial ecosystems subjected to seasonal episodes of waterlogging or submergence (including crop species and agricultural systems). Further information on the ISPA is available at http://utenti.tripod.it/sifv/ispa/

The scientific program of the Conference consisted of oral and poster presentations by a strong field of leading international scientists. The oral presentations were arranged into six mini-symposia:

1A. pH regulation during anoxia
1B. Anaerobic energy metabolism
2. Light/dark cycles and submerged plants

3. Internal aeration and its influence on the rhizosphere
4. Gene expression and acclimation to hypoxia or anoxia
5. Hormones, root-to-shoot signalling, and xylem transport during waterlogging or flooding
6. Crop improvement for waterlogging and submergence tolerance

Seventy-one people, from 18 countries, attended. Twenty-seven of the delegates were Australians.

The conference achieved its primary objective, to enhance communication and sharing of ideas amongst international researchers working on tolerance of plants to flooding (and associated oxygen-deficiency). There was a friendly and open exchange of ideas, but also with critical assessments and discussions. The presentations covered topics at various levels, often integrating across molecular, biochemical, physiological or whole plant levels.

The Conference highlighted the large gains in knowledge on plant adaptation to waterlogging and oxygen-deficiency that have been achieved in recent years, especially at the molecular genetic level. Various approaches to germplasm improvement were presented (e.g. transgenic, wide-hybridizations, doubled haploids), with promising initial results. The need for interdisciplinary research teams in efforts aimed at improving plant tolerance to flooding stress was evident during the discussions.

We gratefully acknowledge the generous contributions made by the following sponsors to the 8th ISPA Conference: ALCOA Australia, Annals of Botany, AusAID, Australian Society of Plant Scientists, CRC for Plant-based Management of Dryland Salinity, Department of Conservation and Land Management – Western Australia, Faculty of Natural and Agricultural Sciences (UWA), Grains Research & Development Corporation, School of Plant Biology (UWA), University of Western Australia (UWA).

A Special Issue containing selected papers from the Conference will be published in the Annals of Botany during 2005. The next ISPA meeting will be held in Sendai, Japan, during 2007.

Tim Colmer
University of Western Australia

ComBio2004 - Perth

Note: This year we have two reports on ComBio to represent the Ecophysiology and Molecular/Cell Biology perspectives

Ecophysiology was better represented at Combio2004 than it has been over the past few years and it was good to see a good turn out from this branch of the society. With such a broad conference, it is inevitable that certain areas go untouched by talks, but there was still plenty to go to with symposia on heavy metal tolerance, salinity and waterlogging, water relations, rare species and root physiology. There were some excellent plenaries as well. Sally Smith brought us up-to-date with arbuscular mycorrhizae, and showed how easy it is to get it wrong when we extrapolate from the glasshouse to the field. Missy Holbrook's talk on the hydraulics properties of leaves was full of new insights, and was complemented well by subsequent talks, such as T.E. Dawson's on the water relations of tall trees. A high light was Mark Stitt's whirl-wind tour of the latest in carbon-nitrogen interactions, using genomics as a tool.

There were a lot of really good posters and it was here that most of what is normally called ecophysiology was presented. Topics included both theoretical and descriptive analyses of the influence of global change (UV, CO_2, pollution), climatic variables, and nutrient and water availability on all aspects of plant growth and metabolism. As usual the posters were only up for a single day and this remains a problem. It was pretty much impossible to get around all the posters you wanted to see. This was particularly true on the Monday, when ecophysiology posters were in abundance — most of us were standing by our own posters and didn't get much of a chance to talk to the other presenters.

One of the good things about Combio is that it brings together plant scientists from different fields and institutions. The Tuesday night dinner was again a great success in this regard, as was the Ecophysiology Field Day held on the final Friday (see Discipline Perspectives). In the light of discussions at the ASPS annual meeting, the ecophysiologists will again hold a 1-2 day satellite meeting associated with Combio next year, probably more along the lines of Ecofizz2003. There are also plans for a separate workshop in November 2005. If you would like to be on the mailing list for either of these, or have any suggestions for next year's Combio, please contact Ros Gleadow at her new email address: rgleadow@bigpond.net.au.

Ros Gleadow

As usual with the Combio meetings, there was a great mix of exciting talks for plant scientists. Picking out some highlights was difficult because of the variety of topics presented, and any omissions on my part, for which I apologise already, are entirely due to a fight with the 'flu keeping me in bed half of the time (the 'flu won...).

One of the most exciting developments was to see how some of the "omics" have advanced to a stage where some interesting biology can be done. After years of sweat over generating and validating tools, sequencing, mapping and mutant generation, the results are coming in fast. It would be impossible not to be impressed by Mark Stitt's combination of massive transcriptome and metabolome analysis of Arabidopsis, which has been so well analysed by bioinformatics that plant metabolism becomes alive on the screen! Harvey Millar, last year's recipient of the Goldacre medal, presented equally impressive proteomics results of plant mitochondria, which must be the most detailed proteomics study in plants so far.

The ability to sample single cell types, for example by laser capture micro-dissection, and analyzing them by transcriptomics has improved the speed and accuracy with which new candidate genes can be identified. For example, Julian Schroeder identified new members of the reactive oxygen species pathway in isolated guard cells by microarray analysis. Together with a collection of calcium spiking mutants, the identification of candidate genes involved in signaling using this "single cell type genomics" system promises a much more detailed understanding of how single cells work. Similarly, laser capture micro-dissection was used by Mike Jones to isolate single giant cells from nematode-induced galls, which were analysed by transcriptome analysis to determine the changes in metabolism of these new cell types.

The area of plant signaling, especially in plant-microbe interactions, has been propelled by both large scale genomic and in depth cell biological analysis of mutants, which is now providing a detailed picture of the defense and symbiosis pathways in plants. Several excellent talks on plant defense by Peer Schenk, Jane Parker, David Jones and Rhonda Foley and Karam Singh, to name a few, pointed to the many roles of receptor like kinases and their action through a network of salicylic acid,

jasmonic acid and ethylene signaling. The symbiosis side of the coin was well represented by Doug Cook and Peter Gresshoff, where again receptor kinases took centre stage, this time to unlock the plant door to their bacterial and fungal symbionts. As it turns out, the same receptor like kinases enable infection of rhizobia and mycorrhizae, and even the calcium-mediated early infection processes are the same. Similarly by recruitment of a receptor kinase, a gene necessary for meristem proliferation in the shoot has been adapted in legumes to control nodule numbers. And in case you thought that you all knew about the benefits of mycorrhizae on phosphorus nutrition in plants, rethink your ideas, because as Sally Smith demonstrated with an elegant series of experiments, some plants don't have any net P benefit from their fungal symbionts, but rather turn down their own P uptake system as the fungus takes over.

The conference was followed by a fantastic field trip to the surrounds of Perth, which dragged us all back from the sterile-grown likes of Arabidopsis in our labs to some real and amazing plants of Western Australia. We are awaiting the full suite of "omics" to explain the beauty of the wild flowers and bizarre shape of the grass trees.

Ulrike Mathesius

At ComBio abstracts from students are selected for talks (usually at least one per symposium) which can be considered an award in itself. However, most students present a poster which forms part of the student poster prize competition. This year the judges were Erik Veneklaas, Rosemary White and Carolyn Schultz and Martha Ludwig acted as coordinator. The student posters were excellent and the judges finally agreed on the following posters. To further celebrate their efforts, the winners were offered the opportunity present an abstract and a figure of their key data to the readers of Phytogen.

Portland Press Prize

Apratim Chakrabarti of the Research School of Biological Sciences, Australian National University for:
POS-MON-088: "Identification of key regions in the tomato *CF-9B* gene involved in disease resistance and cell death response". By **Chakrabarti, A.,** Panter, S., and Jones, D.

The tomato *Cf-9* gene imparts resistance to race 5 of the tomato leaf mould pathogen *Cladosporium fulvum*, which carries the *Avr9* avirulence gene. *Cf-9B*, a homologue of *Cf-9*, protects mature plants, but not seedlings, from infection by races of *C. fulvum* expressing an unknown elicitor. *Cf-9B*, but not *Cf-9*, is also capable of causing necrosis when transiently expressed in *Nicotiana benthamiana* plants. This response is dependent on the presence of a water-soluble, heat-labile protein (Necrosis Inducing Protein, NIP) from *N. benthamiana*. A domain swapping strategy was employed to identify the regions required by Cf-9B for leaf mould resistance in tomato and necrosis induction in *N. benthamiana*. Unlike Cf-9, which requires only the region between LRR5-15 for seedling resistance to *C. fulvum* race 5, Cf-9B requires the entire region between the N-terminus and LRR15 for mature plant resistance to *C. fulvum* race 5,9. However, either the region between LRRs 9-12 or that between LRRs 12-15 was found to be sufficient to induce necrosis in *N. benthamiana*. It was also found that if the N-terminus – LRR5 of Cf-9B is present, LRR16 – C-terminus of Cf-9B must also be present in *cis* for necrosis to occur. Presence of these two Cf-9B regions in *cis* also strengthened the response compared to two Cf-9 regions in *cis*. Presently, we are working towards identifying the sub-region in LRR16 - C-terminus of Cf-9B involved in a proposed *cis*-interaction.

Four ASPS Poster Prizes

Steve Refshauge of the CSIRO, Plant Industry for:
POS-WED-122: "Cool roots not so cool: involvement of low temperature in rhizoctonia root rot of wheat". By **Refshauge, S.,**[1] Watt, M.[1] and Mathesius, U.[2] ([1] CSIRO Plant Industry; [2] The Australian National University)

Rhizoctonia root rot of wheat, caused by the fungus *Rhizoctonia solani* AG-8, develops early in the growing season leading to distinct patches of stunted plants in the field. Low temperature favours this disease, however the mechanism behind this is unknown. We hypothesise that low temperature predisposes wheat roots to infection either by reducing root growth rate, increasing exudation from seeds and roots, or both.

Growth rates of fungi and wheat roots differed significantly with temperature, with similar growth rates at lower temperatures, but four times faster growth of roots compared to fungal hyphae at warmer temperatures.

When presented with exudate-containing seeds or glass beads (controls), *R. solani* hyphae advanced and branched more towards seeds than beads at both at 7°C or 15°C. Seed exudates modified fungal growth more at 7°C than at 15°C by attracting it and making it more branched. This may enhance the likelihood of intercepting roots growing from slowly germinating seeds at cool soil temperatures.

Plants grown at 9°C and 16°C in soil cores extracted from Rhizoctonia field patches revealed that infection sites on roots were significantly closer to seeds when grown at 9°C than at 16°C. Shorter distance between infection sites and seed at low temperature may reduce opportunities for plants to recover by producing branch roots in this region.

The changes in growth of wheat roots and *R. solani* at low soil temperature appear to favour disease. Slow growing plants may provide more time for hyphae to locate and infect roots. The potential of infected plants to recover may be impaired as a result of the proximity of infection to the seed.

Field-grown wheat plants inside Rhizoctonia patches (right) have severely reduced root and shoot growth relative to plants outside infected patches (left). Stained hyphae (arrow) in a cleared length of infected root.

Sandra Tanz of the Department of Biological Sciences, Macquarie University for:
POS-WED-069: "The evolution of the C_4 carbonic anhydrase gene in *Flaveria*". By **Tanz, S**.[1] and Ludwig, M.[2] [1] Department of Biological Sciences, Macquarie University, Sydney NSW 2109, Australia
[2] Schools of Plant Biology and Biomedical and Chemical Sciences, Centre for Microscopy and Microanalysis, The University of Western Australia, Crawley WA 6009, Australia

C_4 plants have evolved multiple times from C_3 ancestors. The genus *Flaveria* contains species demonstrating C_3, C_4 or C_3-C_4 intermediate photosynthesis. We are using *F. pringlei* (C_3) and *F. bidentis* (C_4) to examine the molecular evolution of C_4 photosynthesis. We are focusing on the enzyme carbonic anhydrase (CA), which catalyses the reversible hydration of CO_2. In C_4 plants CA catalyses the first step in carbon fixation, the hydration of atmospheric CO_2 to bicarbonate in the mesophyll cell cytosol. In C_3 plants CA activity in mesophyll chloroplasts is believed to ensure adequate CO_2 concentrations are available for carbohydrate production. We have isolated cDNAs encoding three distinct CA isoforms (CA1, CA2, CA3) from both *Flaveria* species. Orthologous genes encode each CA isoform and real-time

RT-PCR analyses showed that in *F. pringlei* leaves, CA1 and CA3 transcripts are more abundant than CA2 transcripts. In contrast in *F. bidentis* leaves, CA3 transcripts are at least 100 times more abundant than those of the other two CA genes. These results suggest the C_4 *CA3* gene encodes the CA isoform important in C_4 photosynthesis. The *F. pringlei* CA3 coding region has a putative chloroplast transit peptide, whereas the *F. bidentis* CA3 coding region does not. This explains the cytosolic location of the C_4 isoform, but not the different expression levels of the C_3 and C_4 CA3 orthologues. Transcription start sites of the two *CA3* genes have been resolved and the sequences of the 5'-upstream regions have been determined. Putative *cis*-regulatory elements, which might be responsible for the up-regulation of the *F. bidentis CA3* gene, have been identified.

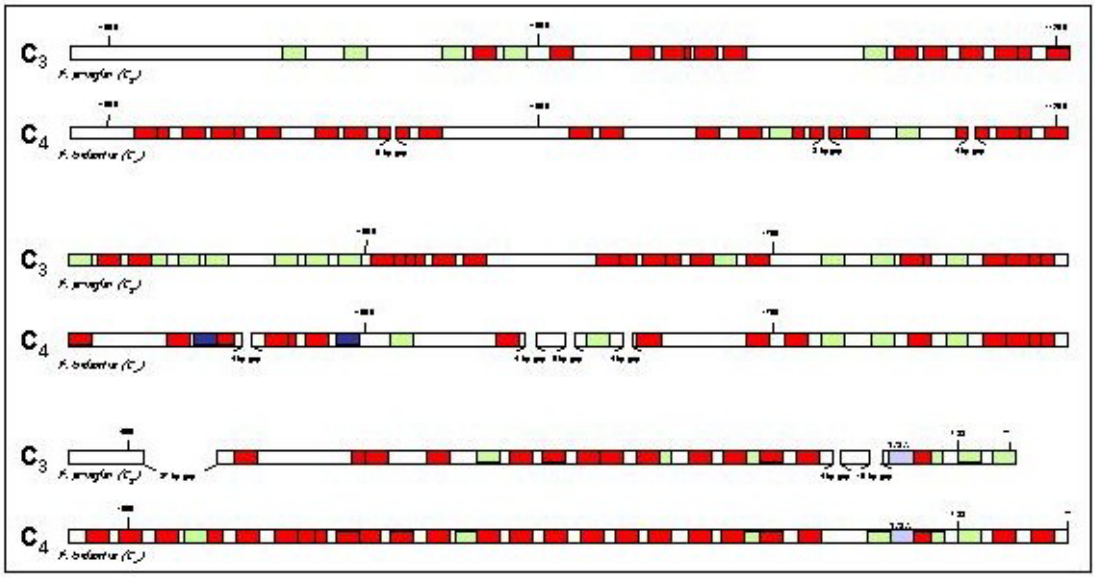
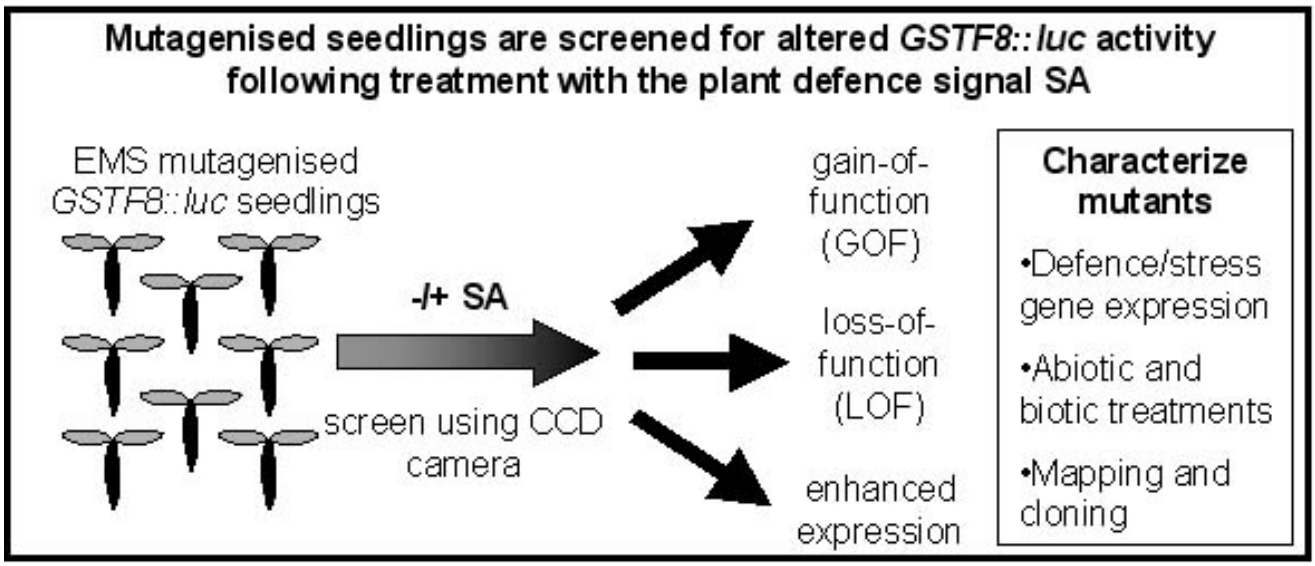


Figure 3: The 5' upstream regions of the *F. pringlei* (C3) and *F. bidentis* (C4) *CA3* genes showing putative *cis*-regulatory elements. The colour code represents *cis*-acting elements involved in light responsiveness (red), CAAT-boxes (green), and a consensus motif found in CO2 responsive elements (blue). The nucleotide numbers are with respect to the translation initiation codon.

Louise Thatcher of the CSIRO, Plant Industry for:
POS-WED-055: "Genetic analysis of plant defence/stress signalling pathways". By **Thatcher, L.[1,2],** Foley, R.[1], Onate-Sanchez, L.[1], Chen, S.[1] and Singh, K.[1] ([1]CSIRO Plant Industry, Centre for Environment and Life Sciences, Private Bag 5, Wembley, WA 6913; [2]Soil Science and Plant Nutrition, School of Earth and Geographical Sciences, The University of Western Australia, Crawley, WA 6009)

An important class of plant defence/stress induced genes are those that code for glutathione S-transferases (GSTs) that work by protecting tissues from oxidative damage or toxic products. Our research focuses on a particular GST (GSTF8) whose gene expression can be induced by a range of elicitors including herbicides, pathogen attack and signalling molecules such as salicylic acid (SA) and hydrogen peroxide (H_2O_2). Using EMS mutagenesis of plants containing the *GSTF8* promoter fused to a luciferase reporter gene (*GSTF8::luc*), we have identified mutants with altered promoter activity before or after treatment with SA using an *in vivo* imaging system.

Two M3 *trans*-acting, recessive mutants were selected for further analysis. A gain-of-function (GOF2) mutant has increased transcript expression of several GST family members, while a loss-of-function (LOF1) mutant has reduced basal and SA-induced expression of several GST members. Additionally LOF1 does not respond to SA or the herbicide Dicamba (synthetic auxin), but interestingly does respond to H_2O_2.



F2 mapping populations have been developed to facilitate mapping and cloning of the mutated genes, with the selected mutants mapping to loci away from known defence mutants. If the identified gene(s) are key regulatory components of defence/stress signalling pathways, we may be able to manipulate these genes to increase the defence capabilities of crop plants.

Anton Wasson of the Department of Biochemistry and Molecular Biology, Australian National University for:
POS-TUE-111: "The role of flavonoids in root nodule development". By **Wasson, A.P.,** Pellerone, F.I. and Mathesius, U.

The nitrogen fixing symbiosis of bacteria of the genus *Rhizobium* and legume plants is a major form of biological nitrogen fixation particularly important in agriculture. In this symbiosis, the legume generates nodules that rhizobia invade and inhabit, fixing nitrogen for the plant. The establishment of this symbiosis, and the generation of the root nodule, requires a complex exchange of signals between the bacteria and the plant. Flavonoids are a class of plant secondary metabolites that perform a variety of roles from UV protection to pathogen defence. They are also involved in the establishment of symbiosis. The plant exudes flavonoids in times of nitrogen deficiency, triggering rhizobia to start the infection process that leads to the development of the nodule. Flavonoids may also act as developmental signals for nodule formation. Flavonoids are transport inhibitors of the plant hormone auxin [1]. It has been proposed that rhizobia manipulate flavonoid levels in the cells of the root cortex causing auxin to concentrate, triggering cell division and the initial stages of nodule formation[2]. Flavonoid and auxin accumulation both occur at the site of nodule development[3]. We hypothesised that flavonoids are necessary for nodule development via regulation of auxin accumulation. To investigate this hypothesis we used RNA interference (RNAi) to knock down expression of chalcone synthase, which encodes the enzyme for the first committed step of the flavonoid biosynthetic pathway, in the model legume *Medicago truncatula*. Composite plants with transformed roots were generated using *Agrobacterium rhizogenes* transformation. These composite roots allow examination of the impact of flavonoid deficiency on nodulation by *Rhizobium* . The effect on auxin is being investigated and the proteome of the flavonoid deficient root mapped. 1. Jacobs and Rubery (1988). Science 241: 346-349. 2. Mathesius et al. (1998). Molec. Plant-Microbe Interact. 11: 1223-1233. 3 Mathesius (2001). J. Exp. Bot. 52: 419-426.

IP Roots & Branches

I have been asked to contribute an article on Intellectual Property being an issue of increasing interest to all scientists. I have titled the article IP Roots & Branches as my aim will be to begin with a broad introduction to IP fundamentals and branch out into more specific topics of interest to plant scientists.

My scientific background included studies in plant physiology and biochemistry in the 1970's and my vocation has been in Intellectual Property as a Patent Attorney for almost 25 years.

Let us begin with a brief overview of Intellectual Property touching on some issues of particular interest for scientists.

Intellectual Property Types

Intellectual Property as its name suggests, is a legally definable form of protection for work resulting from intellectual endeavours. In order to serve this purpose, various pieces of legislation have been devised to protect aspects of intellectual endeavour. These include (but are not limited to):

(a) the Patents Act for protecting the way things work;
(b) the Trade Marks Act, which protects the branding of goods and services;
(c) the Designs Act, which protects the shape, appearance and general look of an object; and
(d) the Copyright Act, which protects a broad range of matters, but mainly literary and artistic works from copying.
(e) In addition to the above clearly defined pieces of legislation, Trade Secrets are also understood as a way of protecting Intellectual Property.

Whilst understanding all aspects of Intellectual Property is important to ensure full coverage and protection of any intellectual endeavour, patents by and large provide the most relevant form of protection for a scientists work and we will take a closer look at patents in this article.

What is a Patent?

A patent is a monopoly right that gives the owner the ability to legally exclude or at least challenge others from entering a particular area of technology. A patent is a legal document comprising a full written description of the invention and a set of claims defining the scope of the monopoly. A granted patent can provide the owner with a source of revenue, commercial advantage and lead time in the marketplace, security for investors and a strong commercial bargaining position. In addition, patents provide a demonstrated step toward commercial viability, which is becoming increasingly relevant in securing Government funding for research.

Patents can be valuable.

Obtaining a Patent

Obtaining a granted patent is a multi-step and, application based process and requires formal documentation of a novel invention, which is also demonstratably inventive. A patent application will be subject to a formal examination process (and possible amendment) before enforceable rights are secured. The written document accompanying the patent application must be sufficiently described to allow the addressee to repeat the invention and the invention must be useful. The novelty and inventive step of a patent application are determined by reference to information publicly available before the first filing of the patent application and this is referred to as the prior art base.

It is important to know the prior art, know what you have invented and to fully describe your invention.

What is Prior Art?

The prior art base is made up of all written and published documentation that is publicly available prior to the filing date of your patent. Prior art includes any publications or publicly available information made by yourself, your colleagues or any one else.

Examples of Prior Art

The written disclosures including publications in journals, patent applications, pre-publications on the internet, poster presentations at conferences, abstracts submitted to conference organisers, hand-outs at conferences, PhD and Honours thesis, Institute and Departmental websites and emails to researches outside your research group all constitute potentially public disclosures and can be damaging to a patent application. In addition to written disclosures, oral disclosures including conference presentations, seminars to which individuals outside your own organisation are invited, conversations with other researches at conferences other than your own collaborators and even telephone conversations with other workers outside your research group, can constitute public disclosures of your invention.

Beware of making your own damaging prior art. File a patent application before disclosing your invention.

Patent Flow Chart

Date (months)	Step	Requirements
0	File provisional to set a priority date that remains available for 12 months.	An invention (not just an idea or a wish list). The whole project does not have to be finished but a full and clear description of at least one reproducible example must be provided.
12	File local "complete" patent application claiming priority or file International application claiming priority.	Finish the work. Tidy up any changes, include all further examples and "fine tune" the invention.
30	Select countries from International application for filing "complete" applications.	Costly step: Commercial decision.
32+	Examination of complete applications by patent Examiner's in each country.	Address patent office objections, mainly argue novelty and inventive step over prior art.
35+	Patents granted.	Pay fees to keep them alive.

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Did you know….?

- ***ASPS Website.*** The ASPS website is regularly updated. We'd like to remind you that if you wish to advertise jobs, PhD scholarships, conferences, books, etc. you can contact Lidia Mischis via advertise@plantsci.org.au. To cover the costs involved, the society has introduced a small charge of $30 for members and $70 for non-members FOR EMPLOYMENT ADS ONLY. Advertising conferences and books (edited by society members or containing chapters written by society members) are FREE OF CHARGE.

- ***Student Travel Funds.*** Funds are set aside each year to sponsor student travel to our annual conference (next year in Adelaide), and in this way 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.

- ***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 in each conference will be about $2500. Funds will be awarded upon the following conditions:

1. The society will be promoted as sponsor of the meeting.
2. The society will be refunded the $2500 or part thereof from any profits made from the conference meeting.
3. The conference organisers will provide a budget for the meeting.

Each application will be considered by the Executive Council on its merits but the conference proposed should fulfil the following criteria:

(i) the conference should support the activities of Australian plant scientists.
(ii) the conference organisers should provide proof that they are applying for funds from other organisations and are supporting the active participation of post-graduate and honours students in the meeting.
(iii) the conference organisers should provide a financial summary after the meeting to the Society.
(iv) after the meeting, the conference organisers will prepare a report to be published in *Phytogen*.

TWIGS & BRANCHES

Some News & Comments from the Plant Science World

Lowering Na^+ levels in shoots

Sodic or saline soils are prevalent in Australia and plants that can lower rates of shoot Na^+ accumulation generally outperform others. Huzain *et al* (2004, *Functional Plant Biology* **31**, 1115-26) show that increasing external Ca^{2+} levels lowers shoot but not root Na^+ levels of several durum wheat genotypes suggesting that Ca^{2+} influences xylem Na^+ loading.

Helen Irving

The dark side of gibberellins

Seedlings grown in the dark exhibit unique etiolated development, including elongated hypocotyl/epicotyl and apical hook, and undergo rapid de-etiolation upon exposure to light. Alabadi *et al.*, (2004, *Plant Physiology* **134**, 1050-7) highlight the central role that gibberellins (GA) play in regulating this developmental transition. Reduction in GA levels or perception, achieved by mutation or chemical application, induces de-etiolation in dark grown Arabidopsis and pea seedlings. Furthermore, GA application can restore etiolated phenotype to dark grown GA deficient pea seedlings.

Brassinosteroids are unmoved

Brassinosteroids (BR) play important roles in plant growth and development but until recently relatively little was known about the role of long-distance transport in regulating BR levels. Symons and Reid (2004, *Plant Physiology* **135**, 2196-206) show that there is no evidence for long-distance BR transport in pea. Defoliation or decapitation had no effect on BR levels in neighbouring tissues, such as stem or leaf. In addition, there was no evidence for acropetal or basipetal transport of BRs in radiolabelled feeding studies or in reciprocal grafts between WT and BR-deficient *lkb* mutant plants. This work has important implications for understanding the way BRs regulate development.

Polyploidy – twice the fun

Polyploidy (genome duplication) has been an important event during the evolution of many plant species, including Arabidopsis, soybean, wheat and cotton. Indeed, many diploid plants are believed to have derived from polyploid ancestors. Blanc and Wolfe (2004, *Plant Cell*, **16**, 1679-91) explore the evolution of gene pairs in Arabidopsis derived from ancient polyploid events. In many cases the two genes have diverged in expression pattern and/or function. Due to this functional divergence, orthologous genes in Arabidopsis and a species of interest may no longer share a similar function. Therefore, this work has important implications for transfer of information from Arabidopsis to more distantly related crop species.

Eloise Foo

UPCOMING CONFERENCES

2nd Australian Model Legume Workshop
Application to Crop and Pasture Improvement

Date: 5–8 April 2005

Venue: Rottnest Island, Perth, Western Australia

Early Bird Registration	1st December 2004
Final Registration	15th January 2005
Abstract Deadline	28th February 2005

More Information can be found at http://www.plantsci.org.au/modellegumeworkshopflyer1.doc

9th International Symposium on Biogeochemistry of Wetlands

Date: 20–23 March 2005

Venue: Louisiana State University campus, Baton Rouge, Louisiana, USA

For more information visit the web site at: http://conference.ifas.ufl.edu/wetlands/

ComBio2005

Adelaide Convention Centre 25 Sep to 29 Sep 2005
For further information: contact Steve Tyerman (stephen.tyerman@adelaide.edu.au)
or Brent Kaiser (brent.kaiser@adelaide.edu.au)
or Kathy Soole (kathleen.soole@flinders.edu.au)

CO_2 Assimilation in Plants: Genome to Biome

(Gordon Research Conferences)

Date: 11-16 September 2005
Venue: Centre Paul Langevin, Aussois, France

For further information, please download conference flyer and visit
http://www.grc.uri.edu/programs/2005/co2.htm

15th Biennial Australasian Plant Pathology Society Conference
Geelong, Victoria in September 2005.

Expression of interest to attend the conference:	5 November 2004
Closing Date for Submission of Abstracts:	27 May 2005
Closing Date for Early Conference Registration:	27 May 2005

More information can be found at: www.deakin.edu.au/events/APPS2005