PHYTOGEN

A
NEWSLETTER
FOR
AUSTRALIAN
PLANT SCIENTISTS

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PHYTOGEN

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INSIDE THIS ISSUE

A big thanks to all the scientists who contributed to this issue of Phytogen. The Editors' wish 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.

Editor's corner

Dear Fellow Society Members,

This is excellent as we have another bumper issue of Phytogen with several exciting articles. The "state of affairs" collated by the Western Australian team of Tim Colmer, Martha Ludwig and Richard Oliver highlights the wide range of research occurring in plant sciences in Western Australia. I certainly hope that you enjoy reading this and the other regular features of Phytogen such as the IP issues and Functional Plant Biology update.

Please keep the articles coming as it is your contributions that make Phytogen a success. A two year roster is in place for the "State of Affairs" and NSW will feature in the next issue, so NSW based members should expect a letter from Dr John Harper early next year. We have several other ways open to members to communicate in Phytogen. For instance, we have introduced a new section for Postgraduate students where students who have had their thesis passed can submit a summary and key figure (see page 8); this will begin next year. We welcome reports from local, national and international meetings relevant to plant science; 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" and "Discipline Perspectives" sections (your Discipline / State representatives are listed on page 2). These sections serve 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.

Those of us involved in the Plant Science research community are becoming used to the acronym RQF (Research Quality Framework) which will bring both challenges and opportunities in the future. One thing is clear; we need to communicate better with the wider community and so those in power. We need to highlight the importance of plants and their contribution to the economy and environment and how our work ranging from fundamental molecular and cell biology to whole plants to global issues contributes to the basic knowledge and understanding of these processes that can have immediate and long term benefits.

I wish everybody a safe and happy festive season and a very productive and successful 2006.

Helen Irving

Message from the President

Dear Colleagues,

First of all I hope 2005 was a successful year for you in the face of the normal challenges. We have all been challenged by proposed changes to the higher education sector and to the research provider sector, as well as to changes in the way research funding is distributed. For those of us that have been in the system for some time it is clear that such challenges and changes are normal and we must learn to take the opportunities that come with them. With the coming RQF exercise many of us will be putting our best foot forward to present our plant science research in the best possible (5-star) light. Competition between institutions will be inevitable and furthermore there is a danger of reduced inter organisational collaboration, depending on the way things are counted. I hope that we can resist these pressures that could be to the detriment of the diversity of plant sciences in Australia so that we can maintain our performance-for-weight position on the world stage. The Society is the ideal forum to discuss issues relating to the RQF exercise and I hope we can provide information on how plant sciences and related disciplines can be presented in the best way to the benefit of the whole of Australia.

I also hope that you are seeing tangible benefits coming from ASPS for your membership. We continue to emphasise our recognition of excellence and support for early career researchers and to this end I am glad to report that we have began using the R.N. Robertson fund to support a travelling fellowship in 2006. All of you should have received details on this so I hope to see a competitive line-up of applications. We have also selected the Functional Plant Biology Best Paper award for 2005 and this will be announced shortly. Please encourage your PhD students and postdocs to submit their best paper to FBP; winning this award will look very good on the CV and the impact factor of FPB is moving up.

Best wishes for the New Year.

Steve Tyerman
President

ASPS News

President's Report 2005

Recently I have been examining the constitution of the Society in order to clear up some details regarding membership of the council and some minor inconsistencies in wording. Although the constitution has served us well over the years as an administrative document it is not the sort of document that provides the reader with the basic tenets of the society and the spirit of the society that is passed on through successive councils. The Web Page states "The Society promotes Plant Science in Australia, and provides professional contact within our community of teachers and researchers in the plant sciences." This is rather bland and does not describe the spirit of the Society that I have come to know over the last 25 years. I would like to state what I think the society is about:

The Society

1. is a group of individuals who are deeply interested in how plants function.
2. provides socialisation of this interest so that we can build both the depth and breadth of our knowledge of plants.
3. provides mutual support.
4. recognises excellence at all levels of scientific career development without fear or favour.
5. nurtures the next generation of plant scientists, by demonstrating how exciting and fun plant science is, and helps them embark on their careers.
6. works on behalf of members to protect their ability to do research and to educate others in plant sciences.
7. acts as a collective life-long mentor.
8. supports a Society based journal that reflects the broad interests of the members.

I am sure there are other forms of words, and individually we may emphasise different aspects, but these words form a guide for me on how to improve the Society and give greater benefit to its members.

In terms of recognition of excellence, this year we have awarded the inaugural FBP Best Paper Award, and in so doing we have cemented our link with the Society Journal.

The teaching award is also given the credit it deserves by having a full address given by the recipient. This award is prestigious and should be keenly sort after by educators in the plant sciences.

Carrying on from Hank Greenway's vision and others for the R.N. Robertson fund, we intend in 2006 to provide the first award under the scheme by providing a sabbatical for an early career scientist, while also boosting the quantum of the fund for future generations.

We are also going to rather belatedly recognise many that have gone before us and have devoted so much to the Society with the award of life memberships. International linkage with senior scientists will also be recognised by nomination of more corresponding members.

In terms of socialisation of our interests, the COMBIO meetings are our main forum and a great deal of effort goes in to making sure we have the best possible balance and time commitment for the membership. I propose that we continue to be a major Society within COMBIO and commit to a

further cycle consisting of Brisbane (2006), Canberra (2007), and Sydney (2008). We also recognise that specialist groups need to get together occasionally and the Society lends in-kind and financial support for these that I encourage you to take advantage of. In this respect we would like to increase this support whereby States (through Discipline reps) can apply for funds that can be used for various activities such as sponsored seminars, small meetings or training workshops. Our Newsletter is also an important way of exchanging ideas and I wish to give due recognition to the excellent job that Helen Irving and Andy Netting have done as editors; please support the newsletter by providing articles.

Within the nurturing component of the Society it was gratifying to see how well the first Postgraduate and Early Career Researcher workshop proceeded and I would like to acknowledge Dr Tim Colmer's vision in organising such a great program and Corrine Jager for the inspiration and an excellent contribution to the proceedings. We intend to do similar workshops at each COMBIO and the council would welcome any ideas on how we can continue to do this with different themes in each year. We will also continue to make attendance at COMBIO as economical as possible for students through travel/registration support and subsidy of social events.

Finally it remains for me to thank the executive for their brilliant support and enthusiasm through the year and to the council members for their efforts. I wish the outgoing council members: Dr Ros Gleadow, Dr Martha Ludwig, Dr Ulrike Mathesius, Dr Marcus Shortemeyer, and student representatives; Corrine Jager, Stuart Pearse, all the very best and many thanks for your input. I also wish to thank the supporting sub-committees; Dr Marilyn Ball (Public Officer), Prof. Graham Farquhar (FASTS representative), Prof. Brian Atwell (Plants in Action), Dr Jennifer Henry (FBP); and Phytogen Editors Dr Andy Netting and Dr Helen Irving.
Professor Steve Tyerman
President ASPS.

RN Robertson Travelling Fellowship

The 2005 Annual General Meeting of ASPS unanimously endorsed the launch of the RN Robertson Travelling Fellowship in 2006. Therefore it is with great pride and pleasure of the ASPS Council to draw to your attention the inaugural launch of the RN Robertson Travelling Fellowship (see Guidelines below and note the closing date of **January 30, 2006**). The named Fellowship recognises and celebrates the sustained contribution made by RN Robertson (Sir Bob) in nurturing young plant scientists in Australia spanning across four decades from the 1950's. Currently with $40,000 of the planned $100,000 of the funds raised (including $20,000 from our own funds) the modest grant of $2000 should be used where possible to leverage further support for the proposed research visit. As the level of secured funds rises, so will the size and/or number of the grants being offered.

The Australian Society of Plant Scientists is indebted to Hank Greenway and Joe Wiskisch who generated and championed the early development of the RN Roberston Travelling Fellowship. In this context, we call on your support to promote the scheme including garnering further sources of funds to reach the target of $100,000.

We also see this Fellowship, as well as the other ways in which we recognise excellence (Goldacre and FPB Best Paper Awards) as a further reason for young plant scientists to consider joining ASPS, so please take every opportunity to point out the benefits to potential new members.

Steve Tyerman

Guidelines for RN Robertson Travelling Fellowship

The fellowship will be 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. The application should conform to the guidelines of the Professor R.N. Robertson Fund as outlined below.

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.

Comments on the objective:

1. "Young" because Bob was renowned for his stimulation of undergraduate and postgraduate students; there will not be an age restriction, but funds will be available only for postgraduate students and postdocs who were awarded their degree less than 2 years of effective research before applying for the award.
2. "Mechanistically (functionally) orientated research" because Bob strongly favoured the establishment of mechanisms (function), even in programs that had a long-term applied aim.
3. The fund will be specifically dedicated to projects that give recipients experience in cooperation with others whose experience is in an area at a different level from their own.
4. Applications from young plant biologists from overseas will also be considered for work in Australia, if it can be demonstrated that the research project will establish or strengthen contacts, and introduce new ideas and techniques into an Australian plant biology department.

Type of project to be supported by RNR Fund: A period of research consistent with the objective of the fund, in a university or research institution. The research should complement the existing research of the applicant by providing access to expertise and facilities outside of that currently available to them and preferably in a field different from the expertise of the applicant, for example a biochemist might work in a unit on molecular biology or biophysics. Funds will be available for a period of research, rather than for attendance at conferences.

***Level of award*:** The level will depend on the objective of the proposal, and would include travel costs and some living allowances. It is expected that the recipient will use the grant to negotiate additional funding from the group with whom they intend to work, or from their existing institution. It is important that the current supervisor of the applicant make considered comments on the scientific and financial viability of the proposed research program.

***Eligibility*:** Young scientists from Australia and beyond, who are doing undergraduate or postgraduate research projects or have completed their PhD less than 2 years of effective research before the closing date of the applications.

***Location*:** For Australian recipients: Australia or overseas, but not in the Australian state where the work for the degree is being or has been carried out. For overseas recipients: Australia.

***Study stage at which grants will be considered*:** Honours, Masters and PhD degrees, all with research as the main objective, and early postdoctorates. The project can be carried out during

the work for the degree or during the first two years of effective research time after obtaining the degree. For Honours and Postgraduate students, the supervisor will be consulted to establish that the study during the fellowship will contribute to the fulfilment of requirements for the degree. However, for Honours for which research is less than 70% of the year's commitment, the period proposed may only begin after graduation, and there should be an intention to enrol for a higher degree by research.

Selection Committee: The selection of the candidate will be decided by a selection committee from within the members of Council and co-opted members of the Australian Society of Plant Scientists subject to there being no conflicts of interest.

***Administration of funds*:** Administration of the fund will be undertaken by the University of Western Australia.

To apply for the RN Robertson Travelling Fellowship go to:

http://www.plantsci.org.au/

and take the :AWARD" link where guidelines and application forms can be found

Closing date: January 30 2006

Postgraduate section in Phytogen

We are proud to announce that student members who have recently completed their PhD and had their thesis passed can submit a summary that will feature in Phytogen in a postgraduate section. The editors feel that this is an important opportunity for our postgraduate students to showcase their research.

Such successful student members are advised that the summary can be accompanied by a key image in suitable format and that they should submit their items to the editors of Phytogen.

ASPS Website

A feast of new information recently was uploaded onto the ASPS website (http://www.plantsci.org.au/). Of particular note are:

1. **Council Members for 2005-2006**. The AGM endorsed David Day as President-Elect along with a number of new Discipline Representatives. New Council members are welcomed and those departing thanked for their valuable contributions (click on the button 'Council Members').
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 (click on the button 'Council Members'). A valuable agreed outcome from the AGM was the launch of the RN Travelling Fellowship that honours the invaluable contribution Sir RN Robertson (Sir Bob) made to mentoring early career researchers in the Plant Sciences (see below).
3. **RN Travelling Fellowship.** The 2005 Annual General Meeting of ASPS unanimously endorsed the launch of the RN Robertson Travelling Fellowship in 2006 with applications closing January 30, 2006 (click on the button 'Awards'). The named Fellowship recognises and celebrates the sustained contribution made by RN Robertson (Sir Bob) in nurturing young plant scientists in Australia spanning across four decades from the 1950's. The Australian Society of Plant Scientists is indebted to Hank Greenway and Joe Wiskisch who generated and championed the early development of the RN Roberston Travelling Fellowship. In this context, we call on your support to promote the scheme including garnering further sources of funds to reach the target of $100,000 (click on the button 'About ASPS' to locate the downloadable form).
4. **Goldacre and Teaching Awards**. Nominations for these prestigious awards will close on April 14, 2006. Please give thought to nominating a deserving recipient. Guidelines and selection criteria are outlined in the relevant web pages (click the button 'Awards').
5. **Corresponding/Life Members**. These members are listed together with criteria for their selection (see 'About ASPS). ASPS members are encouraged to nominate candidates for these esteemed positions.
6. **ASPS Support for Workshops and Conferences**. As one initiative to promote plant science within the national research community, ASPS provides seeding support for members to run workshops and conferences. Guidelines and a downloadable application form are available on the website (click on the button 'Conferences').
7. **2006 Membership Renewal**. Deadline for renewal of ASPS membership is set at March 31, 2006. A downloadable form is available from the web (click the button 'Join ASPS'). Please note that form provides an opportunity to make a donation to the RN Robertson Fund if you have not already done so. In addition, please note that Functional Plant Biology has been joined by Beckmann Coulter, Corbett Research and GeneSearch as valued ASPS Sustaining members. If you know of any company that would be interested in becoming a Sustaining member, please contact Peter Ryan (peter.ryan@csiro.au) with the relevant information.
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 is available to the FASTS website from the "About ASPS" page.
9. **ASPS Promotional Material**. An ASPS Flier and an ASPS Poster are available on the website as downloadable pdf files (see About ASPS). ASPS member are encouraged to use this material to promote the Society within their institution or elsewhere.

DISCIPLINE AND STATE PERSPECTIVES

Ecofizz 2005 at Stradbroke Island

from Charles Warren (the new Ecophysiology rep on ASPS) with some help from Ros Gleadow (the retiring rep).

The Ecofizz 2005 conference was held at Stradbroke Island from Monday 28 November until Wednesday 30 November. This idyllic location hosted more than 40 people, including approximately 10 postgraduate students. Almost all participants gave oral presentations. Presentations were incredibly diverse and covered topics such as greenhouse gas emissions, functional traits, secondary metabolites, water use, and high and low temperatures. The majority of presentations focussed on Australian plants or Australian ecosystems, with a smattering of presentations on Antarctic, European and North American ecosystems. The group was quite international with delegates from France, Germany, Austria, Viet Nam and the United States. The diversity of high impact science presented really does show that Australian ecophysiology is alive and well. It was especially pleasing to see the large number of high calibre presentations by students and early career researchers.

Picture 1: EcoFizz delegates going for an early morning swim at Cylinder Beach, North Stradbroke Island. (Photo RG)

In addition to these short scientific presentations, considerable time was devoted to presenting and workshopping methods. Methods-related talks included FT-IR microspectroscopy, measurement of respiration of woody tissues (stems, branches etc.), thermography, and measurement of internal conductance. Representatives of ICT international showcased methods for measuring soil moisture and sap flux of trees. These methods were field tested on Tuesday and Wednesday morning, giving all participants a chance to see the gear in action (see picture 2).

Picture 2: Sharon Robinson, Susanne Schmidt and Cath Lovelock discuss the finer points of measuring soil respiration at one of the field sessions at EcoFizz2005. (Photo RG)

Stradbroke Island was a superb location for Ecofizz 2005. Early morning swims at Cylinder beach were a brilliant way to start the day, and a pleasant change from the drudgery of city-based conferences (see picture 1). Stradbroke hosts a variety of ecosystems and these served as a useful playground for our testing of new methods (see picture 2). The laid back atmosphere was particularly pleasing. Beach attire was standard, shoes and collared shirts were scarce, and there was plenty of time for discussions during meal and coffee breaks.

Everyone had a great time at Ecofizz 2005 and we extend our warmest thanks to Susanne Schmidt for organising the conference. We are also grateful for financial support of The University of Queensland and ICT International and the staff of the Research Station.

Picture 3: Turtle spotting from a safe spot. (photo RG)

The Melbourne Plant Group

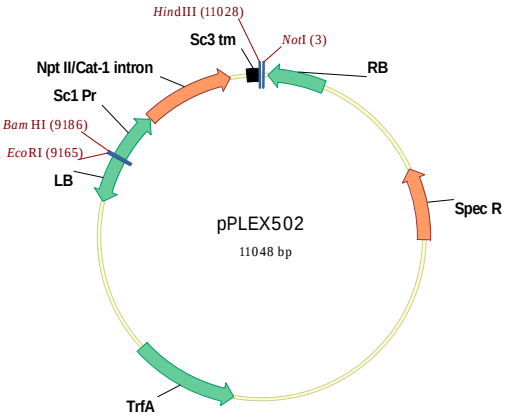
Two years ago John Golz (School of Biological Sciences, Monash University) and Ed Newbigin (School of Botany, Melbourne University) decided to organize a series of meetings in which the many plant molecular biology groups in Melbourne come together to discuss their latest research. To date these meetings have been held every two months in the new wing of the School of Botany at Melbourne University and typically involve a graduate student from two different groups presenting their work in an informal and friendly atmosphere. Feedback from the meetings has been overwhelmingly positive as students, research fellows and group leaders alike enjoy the friendly environment, the chance to make new contacts and hear about all the great research that is going on in Melbourne. In addition, the generosity of the Plant Cell Biology Research Centre ensures that no one goes hungry of thirsty. Occasionally visiting scientists are enticed to talk about their work, so for example in the November meeting Prof. Richard Oliver from the Murdoch University (WA) gave a talk about his work into how legumes resist infection by necrotrophic fungi. Next years meetings are still being planned and, so if you are interested in coming along contact John Golz (john.golz@sci.monash.edu.au), who will be happy to send the 2006 program once it has been finalized.

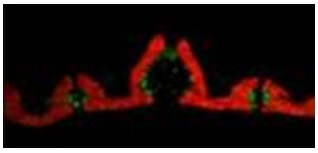
from John Golz

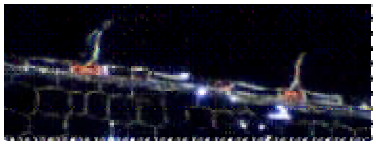
Vale Petra Schünmann

It is with great sadness that we inform you of the passing of Petra Schünmann on the 30th November 2005. Petra was a colleague of ours at the CSIRO Plant Industry labs in Canberra since 1994 and finally succumbed to a cancer that she fought with determined courage. During her time at Plant Industry Petra was meticulous and hardworking and a tremendous asset both for her research and friendship. We recall how she faced her first bout with cancer with a clear mind and matter of a fact approach and did not flinch from the trials that lay ahead. All went well and Petra thrived, but after just one year, we were all again devastated by the news that the cancer had returned. Once again she faced the difficult times and put her faith in chemo and radiotherapies. During this time Petra continued her research and maintained an optimism that at times made us forget the seriousness of her condition. Petra did however make the most of her final year and spent time in the Cook Islands, a corner of the planet that was special to her and Andrew as the place where they were married. While it is certain that there were difficult times during the last months, she maintained a strong will to live and took every shot she could to beat the cancer. Although we bid farewell to Petra, and will miss her, her legacy lives on in her research achievements. In particular her elegantly designed plasmid vectors (such as the pPLEX series) for monocot transformation will live on. Below are images from Petra's work that summarise some of her research highlights.

Manny Delhaize, Alan Richardson, Diane Hebb and Peter Ryan
CSIRO Plant Industry, December 1, 2005







Focusing on one state's research per edition

Western Australia

Collated by Martha Ludwig, Tim Colmer and Richard Oliver
(the discipline representatives resident in Western Australia)

Welcome to the feature article highlighting some of the research in plant science by ASPS members in Western Australia.

DEPARTMENT OF AGRICULTURE, WESTERN AUSTRALIA (DAWA)

Dr. Tim Setter

Physiology work at the Department of Agriculture, Western Australia (DAWA), focuses on abiotic stress tolerance in wheat. This includes work on tolerance to drought, waterlogging, microelement toxicities, sprouting and salinity. This research work is completely integrated with DAWA wheat breeders, and it is supported by ACIAR, GRDC, MPBCRC and ARC projects. All work involves characterisation of germplasm for (1) tolerance relative to non-stressed plants and (2) one or more major mechanisms of tolerance. All work is supervised by Dr.Tim Setter.

The overall goal of this work is to improve tolerance of breadwheats to abiotic stresses. The four aims of work are to:

1. Develop reliable and efficient screening techniques based on adaptive traits that can be used to select and evaluate tolerance traits in large breeding populations or germplasm collections.
2. Identify existing and new sources of tolerance of wheat to abiotic stresses from novel genetic recombinants and international accessions screened in the glasshouse and field.
3. Use and develop the latest breeding technologies including Marker Assisted Selection (MAS) to develop tolerant germplasm (MAS work is conducted exclusively through the MPBCRC).
4. Develop new abiotic stress tolerant germplasm relying on rapid genetic fixation such as doubled haploids (DH). Currently we have 22 DH populations with over 4000 lines available for a range of abiotic stresses; 6 additional populations will be completed by 2006 for waterlogging, salinity and sodicity tolerance.

Summaries of drought, waterlogging and sprouting tolerance work are presented below.

Drought tolerance research *(Andreas Neuhaus, Irene Waters)*

DAWA is currently involved in ongoing and developing drought tolerance projects in collaboration with national and international partners. DAWA is a leader in research on drought tolerance of wheat across WA with some of the largest field trials being conducted under controlled conditions at Wongan Hills. Ongoing drought tolerance research is supported by the Molecular Plant Breeding Cooperative Research Centre (MPBCRC) and GRDC. MPBCRC work started in 2004 and terminates in 2010; the budget is approximately $1.5 million and involves collaboration between DAWA and Murdoch University.

Drought tolerance work currently focuses on tolerance to terminal drought, i.e. drought during grain filling. Drought tolerance is evaluated in the target environment using portable rainout shelters (9x40m). Irrigation facilities are established in the field at these sites to eliminate pre-treatment water deficits and to assure that control treatments are not also exposed to drought under natural conditions.

Mechanisms of drought tolerance focus on accumulation of stem carbohydrates (fructans) at flowering as a means to tolerate the adverse effects of terminal water deficits. Varieties and doubled haploid lines are being phenotyped in the target environment for development of molecular markers for adaptive traits to assist breeding programs in wheat improvement.

In a preliminary experiment in 2004, over 4000 samples for grain yield were collected from 350 varieties and breeding lines grown in the field at Wongan Hills under various drought and non-drought conditions. In 2005, over 2500 samples from 360 genotypes were collected in the field for stem carbohydrates using over 1.5 t of dry ice (to fix labile samples) and a harvesting team of up to 9 staff. Subsequently over 2000 grain samples were collected from controlled drought and irrigated treatments using 36 commercial varieties and two doubled haploid populations differing in stem carbohydrates at flowering.

Waterlogging tolerance research *(Glenn McDonald, Hossein Saberi, Irene Waters)*

The aim of this project is to produce waterlogging tolerant breeding lines of wheat for Australian and Indian target environments by identifying and evaluating the genetic basis of physiological traits conferring waterlogging tolerance in wheat, so that traits can be combined in improved breeding lines. A major waterlogging tolerance facility is established at Katanning, WA, capable of screening hundreds of genotypes per year for waterlogging tolerance under controlled conditions in a range of soils.

Environmental characterisation has: (i) Confirmed that waterlogging is a “hidden constraint” to wheat production in Australia and India; (ii) Led to identification of multiple waterlogging environments based on the predisposition of soils to different microelement toxicities, and (iii) identified major new constraints of B, Mn, Fe and possibly Al toxicity likely to affect large areas of wheat production in sodic soils exposed to waterlogging in India.

Germplasm evaluation was the major activity in 2005 for all DAWA partners. In 2005, approximately 9000 pots of 300 genotypes were sown in four different soils and exposed to waterlogged and control (drained) treatments at Katanning; waterlogging lasted 7 weeks to optimise discrimination. In other work at South Perth, rapid screening protocols were developed in 2005 to increase screening by 50 to 100 times using bulked DH populations or segregating populations – this was successful resulting in the clear identification of populations with high, medium and low tolerance to waterlogging. Such protocols will enable rapid screening of large numbers (1000’s) of germplasm so as to identify populations / crosses for more detailed evaluations.

In 2005, eight crosses were developed for waterlogging and salinity tolerance, and at least one doubled haploid population with at least 200 lines is expected to be available for evaluation by 2006. At present, 11 doubled haploid populations (~1500 lines) are available based on parental lines with waterlogging tolerance at different stages of development or in different soils; six additional populations (~1200 lines) are expected by 2006. These different populations are suitable for locations ranging from pH 4-10, with single or multiple abiotic stresses, or with waterlogging at different stages of development.

Physiology work has focused on critical evaluation of mechanisms of tolerance to waterlogging. This year the project has reviewed major physiological traits including Na, B, Al, Mn and Fe toxicities, aerenchyma development and recovery ability, alcoholic fermentation, carbohydrate accumulation, anoxia tolerance and antioxidant metabolism, and agronomic traits, including tillering and plant height; this work is done in collaboration with project partners including the University of Western Australia. Mechanisms of tolerance which relate most to waterlogging tolerance are those associated with tolerance to a wide range of microelements. The current hypothesis is that waterlogging tolerance is a product of (1) tolerance/avoidance of anaerobiosis and (2) tolerance to microelements (Setter et al., 2004). Interactions with different microelements in different environments, explain why waterlogging tolerance and ranking of germplasm often varies between environments.

Sprouting tolerance research *(Ben Biddulph, Postgrad. researcher, UWA and DAWA).*

Preharvest sprouting refers to the precocious germination of grain in the head prior to harvest primarily as a result of untimely rainfall. This problem affects many wheat producing countries and areas of both the Southern, (WA and SA) and Northern (NSW and QLD) areas of the Australian wheat belt because locally adapted high yielding cultivars lack sprouting tolerance, and there is a yield penalty associated with growing older, sprouting tolerant cultivars. However breeding for sprouting tolerance or seed dormancy, the main mechanism of sprouting tolerance, is difficult as the environmental conditions during grain filling can significantly alter the dormancy phenotype in all genotypes.

A GRDC PhD Project [“GRS66 Interactions between environmental factors and mechanisms involved in preharvest sprouting tolerance in wheat”] to look at this, runs until June 2006 and includes supervisors from DAWA (T Setter), UWA (J Plummer) and UA (D Mares), and staff from CSIRO PI Canberra (F Gubler).

To date five hard white spring wheat genotypes with a range of dormancy levels were exposed to irrigated or drought treatments in the field at high or low temperature over three successive seasons. Dormancy and embryo sensitivity to germination inhibition by exogenous abscisic acid (ABA) were analysed throughout grain filling.

There have been two main conclusions from this investigation. Firstly, drought during grain filling combined with high temperature and low humidity during the soft dough stage, was associated with an apparent induced embryo sensitivity (to ABA) and an increase in seed dormancy in wheat grains like Cunderdin at physiological maturity. Secondly, whilst dormancy as measured by a germination index (GI), was affected by both temperature and drought, genotypes maintained their relative rankings across environments. In summary environmental conditions such as drought and high ambient temperatures during grain filling can have a large effect on the expression of dormancy. Avoidance of drought, and maturity x drought interactions, are important prerequisites in screening genotypes with genetic differences in grain dormancy.

CSIRO PLANT BIOTECHNOLOGY GROUP - PERTH

Dr. Karam Singh

The CSIRO Division of Plant Industry established a plant biotechnology group at Floreat Park, Perth in 1999. The group is addressing plant responses to disease and insect pests, which are major issues facing the agriculture communities in the Southern and Western parts of Australia. A major activity is the analysis of defence/stress responses in roots using the model plant, *Arabidopsis thaliana*. Another major research area is the development of a suite of complementary projects in legumes using *Medicago truncatula*, a model legume. The group which currently consists of 2 Research Scientists, 4 Post-doctoral fellows, 3 PhD students and 4 Research Associates has grant support from a variety of sources including substantial support from GRDC. The group has established very good links with other leading research groups in WA including as detailed below with the ACNFP at Murdoch University, but also with groups at UWA and the Department of Agriculture.

AUSTRALIAN CENTRE FOR NECROTROPHIC FUNGAL PATHOGENS

Prof. Richard Oliver

Cereal, pulse and oilseed production in Australia and world-wide is subject to major losses caused by necrotrophic fungal pathogens. Necrotrophs are defined as pathogens that acquire nutrients from dead or dying tissues of plants. The major genera are *Stagonospora*, *Mycosphaerella* (*Septoria*) and *Pyrenophora* on cereals, *Leptosphaeria* on canola and *Ascochyta* and *Colletotrichum* on legumes. The annual cost on wheat in Australia alone is estimated at $M180. Starting in 2000 and primarily funded by GRDC, the ACNFP has established major research programs aimed at understanding the molecular basis of fungal pathogenicity and plant resistance, with a specific focus on necrotrophic diseases. These programs are designed to generate the knowledge needed to develop novel genes that will confer resistance to necrotrophs.

The Biotech lab in CSIRO and the ACNFP are working closely in some areas and have distinct research projects in other areas.

Dissection of pathogenicity of necrotrophic fungi (ACNFP)

Dr Peter Solomon, Dr Wenfeng Li, Kar-Chun Tan, Rohan Lowe, Ormonde Waters, Kasia Rybak, Maryn Lord and Prof Richard Oliver in collaboration with Dr Rob Trengove (Murdoch) and Prof Harvey Millar (UWA)

Our approach is to study the roles of individual genes in the pathogenicity of *Stagonospora nodorum*, cause of the wheat Septoria nodorum blotch disease. We have developed a series of tools that have allowed us to investigate the roles of many genes in pathogenicity. These include cDNA libraries to isolate about 4000 different fungal genes and the whole genome sequence, the largest genome project in the Southern Hemisphere. To select genes for detailed analysis, we have developed bio-informatics methods to identify genes (a) that are differentially expressed during

infection; (b) that have significant similarity to genes from other fungal pathogens; and (c) that are specific to fungi. We are routinely using GC-MS to quantify and identify fungal metabolites and proteomics to identify fungal proteins.

From left to right: Richard, Ormonde, Maryn, Peter, Rohan, Kasia, Wenqfen and Kar-Chun

We have developed medium-throughput methods to ablate the expression of a gene. The resulting "knock-out" mutants are then assayed for alterations in pathogenicity. If affected, the strain is examined for alterations in phenotype using microscopy, proteomics, transcriptomics and metabolomics. Using these methods, we have analyzed the role of about 20 genes. Two genes in particular appear to have critical roles in disease development. The inactivation of a G-alpha subunit lead to the finding that *S. nodorum* produces melanin via the L-dihydroxyphenylalanine (L-DOPA) melanin synthetic pathway rather than the presumed dihydoxynapthalene (DHN) pathway. This has implications for disease control as the DHN pathway is the target for the commercial fungicide tricyclazole. In primary metabolism, the inactivation of mannitol 1-phosphate dehydrogenase has shown that the mannitol cycle is required for sporulation. As *S. nodorum* is polycyclic, the ability to stop the pathogen sporulating has obvious disease control consequences.

Molecular dissection of plant defence/stress gene expression in *Arabidopsis thaliana* (Biotech lab CSIRO)

Dr Rhonda Foley, Dr Jonathan Anderson, Louise Thatcher, Pia Sappl, Hayley Casarotto, Elaine Smith, Dr Karam Singh in collaboration with Prof. Harvey Millar, UWA.

(L-R) Hayley, Elaine, Rhonda and Louise, members of the Arabidopsis gene expression

One area of research interest in Arabidopsis is utilising genomic approaches to study glutathione S-transferase genes. A major focus is on the *GSTF8* gene whose expression can be induced by a range of elicitors including herbicides, pathogen attack and signalling molecules such as salicylic acid (SA). Analysis of the *GSTF8* promoter shows several layers of complexity. Firstly, it contains several motifs important for abiotic and biotic induced expression, including the already characterized *ocs* element. On another level, the *GSTF8* gene has several possible transcription start sites which can give rise to alternate transcripts with differential expression patterns and whose protein products maybe targeted to alternate subcellular compartments. Using transgenic plants containing a *GSTF8* promoter::luciferase reporter construct (*GSTF8::luc*), and a sensitive in vivo imaging system, we have been able to analyse the spatial and temporal effects of abiotic and environmental stresses on *GSTF8* promoter activity. Using EMS mutagenesis of plants containing *GSTF8::luc,* we have identified mutants with altered promoter activity before or after treatment with SA or hydrogen peroxide. Other areas of interest are transcription factors involved in defence/stress gene expression including members of the TGA and ERF families.

Genetic basis of resistance to fungal necrotrophs – ([1]ACNFP & [2]Biotech lab CSIRO)

Dr Simon Ellwood[1], Dr Theo Pfaff[1], Dr Jonathan Anderson[2], Dr Judith Lichtenzveig[1,2], Lars Kamphuis[1], Nola D'Souza[1,2], Stephanie Whitehand[2], Joel Gummer[2], Angela Williams[1], Emma Groves[1], Prof Richard Oliver[1] and Dr Karam Singh[2]

The Medicago-necrotrophs project is a collaborative enterprise led by Richard Oliver (ACNFP) and Karam Singh (CSIRO) in close interaction with CLIMA (UWA) and the Agriculture Department in WA. The project is funded by GRDC. The research group comprises four post-doc fellows, two PhD students and three research assistants. This group is investigating the response of *Medicago truncatula*, which is phylogenetically related to the most important legume crops (pea, faba bean, chickpea, lentils, lucerne and clover), to various species of necrotrophic fungi.

"Dissecting the genetics of whatever comes in hand" (left to right: Stephanie, Joel, Jonathan and Judith)

Cultivation of legumes is severely constrained by a lack of suitable genetic resistance to necrotrophic pathogens in Australia and worldwide. The diseases we are most interested in include Ascochyta blight, a major constraint in production of chickpea, lentil and faba bean, Grey Mould in chickpea and Black Spot in field pea (caused by *Botrytis* spp), Leaf-spot in pea (*Phoma* spp), Brown-spot and root rot in lupin (*Pleiochaeta* setosa), seedling damping of and root rot in various crop species (caused by *Rhizoctonia solani*, *Phytophthora medicaginis*, *Fusarium solani*) and Fusarium wilt (*Fusarium oxysporum*).

"Genotyping"
(left to right: Simon, Angela and Lars)

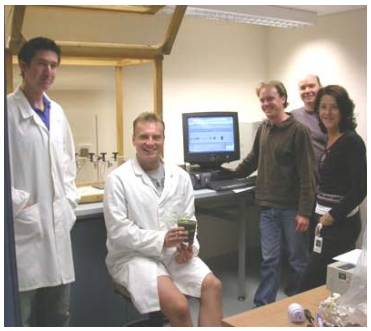
To identify genetic components of plant resistance we have screened a collection of 100 *M. truncatula* accessions for differences in susceptibility to several fungal and oomycetes species. The identification of genes involved in the pathogen recognition (classical R-genes) or in the defence reaction should aid to the recognition of homologous genes in other legume crops. Alternatively, the genes could be transferred to legume crops.

Crossing Mt accessions"
(left to right: Emma, Theo and Nola)

Several techniques are being applied in this study: classical and quantitative genetics approaches to analyse the genetic basis of the resistance response, histological evaluations of the host-pathogen interaction, and molecular approaches such as transcription profiling, analysis of mutants with disrupted signalling pathways for their resistance response, transient and stable transformations and metabolomics analyses.

Aphid Resistance in *Medicago truncatula* (Biotech lab & Entomology CSIRO)

Dr John Klingler, Dr Lingling Gao, Dr Jonathan Anderson, Robert Creasy, Rick Horbury, Louisa Bell, Joel Gummer, Hayley Casarotto, Peter Swinkels, Jenny Reidy-Crofts, Dr Ram Nair (SARDI), Dr Hellen Spafford Jacob (UWA), Dr Owain Edwards and Dr Karam Singh.

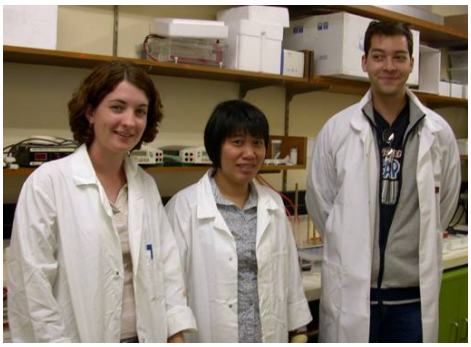


(L-R) Joel, Rob, Jonathan, John, Jenny, members of the aphid resistance group, using electrical penetration graphs to study aphid feeding behaviour on resistant and susceptible plants.

Aphids and related phloem feeding insects cause severe plant damage, through feeding activities and as vectors of plant viruses. A collaborative project between the laboratories of Karam Singh (CSIRO Plant Industry, WA), Owain Edwards (CSIRO Entomology, WA) and Ram Nair (SARDI, SA) is using the model legume *Medicago truncatula* to investigate molecular mechanisms of aphid resistance. We have mapped genes conferring resistance in *M. truncatula* to several major aphid pests of legumes using near isogenic lines and have identified three modes of resistance to blue green aphid in one line: antixenosis (non-preference by the aphid); antibiosis (negative impact on aphid biology); and tolerance (little plant damage under aphid infestation). The underlying molecular mechanisms conferring resistance to blue green aphid and a number of other aphid species is also being investigated. Resistance to blue green aphid appears to be phloem based and quantitative PCR and microarrays containing 16,000 *M. truncatula* genes have been used to identify several metabolic and signaling pathways exclusively associated with resistance to the aphid. The knowledge gained has potential for aphid protection across both legume and non-legume crops.

Translational genomics in legumes (ACNFP, Biotech lab CSIRO)

Dr Huyen Phan, Dr Simon Ellwood, Dr Rhonda Foley, James Kyawzer Hane, Holly Yeatman, Elaine Smith, Dr Karam Singh and Prof. Richard Oliver in collaboration with Prof. Doug Cook, University of California, Davis.



Left to right: Holly, Huyen and James

Orthologous markers that are transferable between distantly related species allow the rapid generation of genetic maps in species where there is little genomic or EST information. We are using the model legume *Medicago truncatula* to develop such molecular markers in legumes of importance to Australian agriculture such as lentil, lupin, lucerne, and faba bean. This will enable the construction of comparative genetic maps, help to determine patterns of chromosomal evolution in the legume family, and characterize syntenic relationships between *M. truncatula* and cultivated legumes. This information can then be used to identify markers tightly linked to the genes of interest, candidate gene(s) for a trait, and expedite the isolation of such genes. This project is funded by ARC and is in collaboration with Dr Rebecca Ford (Melbourne University), Dr Steve Thomas (NSWAg) and Dr Yang (DAWA). Work on *Lupinus angustifolius* has benefited from additional collaboration with Bevan Buirchell (DAWA) Matthew Nelson and Wallace Cowling (UWA) and Mike Jones, Mehmet Cakir and Matthew Bellgard (Murdoch). BAC library resources for *L. angustifolius* are being developed to facilitate the cloning of agronomically important genes and this is being done in collaboration with Prof. Doug Cook (UC Davis). Altogether these resources will help accelerate the generation of lupin physical maps. We are also identifying resistance gene analogs in lupins using a high throughput genomic approach and this also involves collaboration with Prof. Cook.

ARC CENTRE OF EXCELLENCE IN PLANT ENERGY BIOLOGY COMES TO PERTH

Harvey Millar, Jim Whelan, Steven Smith

June 2005 saw the announcement of funding for a new ARC Centre focused on plant biology and based in Western Australia. The Centre brings together the laboratories of Harvey Millar, Jim Whelan and Steven Smith with colleagues in Sydney (David Day) and Canberra (Murray Badger and Barry Pogson). The team is completed by Ian Small from Evry in France, who is current running a plant genomics centre in INRA and will relocate to Perth in early 2006 to take up his recently announced position as a WA Premier's Research Fellow and Director of the ARC Centre of Excellence in Plant Energy Biology. Together they will be establishing a research agenda focused on understanding the interplay between chloroplasts, mitochondria and peroxisome functions in Arabidopsis plants. Using the power of genetics in Arabidopsis coupled to transcript, proteome and metabolome analysis, they hope to discover and characterise the molecular components and control mechanisms that drive energy metabolism in plant cells.

Check them out at www.plantenergy.uwa.edu.au for the latest news and job opportunties.

UNIVERSITY OF WESTERN AUSTRALIA

Plant water and Nutrient Use in Ecosystems

Steve Burgess and Hans Lambers

The plant communities that form south-western Australia's biodiversity hotspot are a fascinating opportunity to study the diverse nutrient and water acquisition strategies which flourish under resource poor conditions. Lying under the threatening shadow of dryland salinity, these communities themselves may hold the answers to arresting its expansion.

There is abundant evidence that European-style agriculture contributes to dryland salinity by its inability to adequately capture water resources. We need to learn from and mimic the water use characteristics of native plant communities in order to redesign agroecosytems that are hydrologically sustainable. We hypothesise that low drainage under native vegetation is a result of niche filling by a diverse assemblage of plant species, such that wherever or whenever soil water is available, one or another type of plant will always be able to utilize it. We have been tracking the water use behavior of about 16 species that grow on various parts of the gently sloping wheatbelt landscape near Corrigin, WA. We are particularly interested in the use of summer pulses of precipitation and pumping of deep reserves of soil water built up from winter rains.

In woodland areas we have identified important ecosystem services provided by salmon gum and wandoo eucalypts in terms of their ability to redistribute water through the soil profile and also maintain rapid transpiration throughout summer. We are applying eddy flux, sap flow and LAI estimates to understand just how big a hydrological footprint these woodlands have in terms of using more than their fair share of precipitation.

In heath regions with shallower soils we have uncovered a huge range among sympatric species with respect to their degree of summer dormancy and associated ability to maintain transpiration over summer as well as make use of episodic summer rain. Though multiple-trait analysis we are hoping to better understand the groupings of traits that are associated with different water use strategies. The ultimate aim is to use this type of information in selecting optimal species when designing hydrologically sustainable agroecosystems.

Plant water and Nutrient Use in Ecosystems

Erik Veneklaas.

My research focuses on plant water and nutrient use in a range of natural, rehabilitated and agricultural ecosystems. An important line of research addresses different ways in which plants deal with seasonal or pulse-based water availability, in the Mediterranean-type climate of southwest WA and in the arid interior. The deciduous habit is very uncommon in native ecosystems, and I have recently shown that seasonal variation in plant foliage area of evergreens is quite limited due to the long mean leaf lifespans and the typical growth phenology of most these species. Consequently, during summer plants either rely on access to stored soil water, or a well-developed capacity to tolerate tissue water deficits. In a number of projects we are studying patterns of plant water use as related to rooting depth, stem hydraulic conductivity, stomatal behaviour and leaf osmotic and elastic properties. This includes projects in the context of dryland salinity (mimicking key properties of native ecosystems in new land uses), minesite rehabilitation (eucalypt forest), tree decline (eucalypt and banksia woodland), and woody crops (vines, olives).

Another of my research interest centers around plant phosphorus uptake and use. We have demonstrated the importance of the proteoid root structure and rhizosphere chemistry (root-exuded carboxylates and phosphatases) for phosphorus uptake in low-phosphorus soils in both native Proteaceae and crop species, in particular grain legumes. In Banksia (>50 spp in WA), this mechanism shows little variation across the genus. In grain legumes (lupins, chickpea, field pea, faba bean etc) there is considerable variation, which can be exploited to optimise crop phosphorus use efficiency and provide rotational benefits to cereals.

Studies on anoxia tolerance of plant tissues

TD Colmer and H Greenway

1. A model system of coleoptile tips of rice has been developed. In the presence of glucose, this system survives anoxia for at least 5 days, as demonstrated by fast uptake of K^+ and Cl^-, when the tips are returned to air. In a PhD study, Shaobai Huang showed that under anoxia, energy requirements for maintenance are reduced several fold. Manipulation of the rate of ethanolic fermentation, by varying the level of glucose supply, allowed assessment of the

minimum requirements for maintenance (Huang *et al*., 2004). A well established difference in tolerance of genotypes was shown to be due to differences in sugar mobilisation, not to differences in enzymes of anaerobic catabolism (Huang *et al*. 2003).

2. In maize roots, anoxia tolerance depends on a combination of hypoxic pre-treatment, availability of at least 50 mM glucose and 4-5 h healing after excision, or manipulation of the roots. The system with the best tolerance still has no net uptake of K^+ and Cl^-, but does show glucose uptake against a free energy gradient. Such data complement the extensive knowledge for maize roots on anaerobic catabolism, by establishing survival of tissues of different age and retention of their integrity as gauged by ion uptake after return to air.

3. A review on the effects of CO_2 at pressures of 10-40 kPa on roots in waterlogged and flooded soils has been submitted to the *Annals of Botany*. Data are scarce, but modelling makes some reasonable predictions on the factors which will determine CO_2 concentrations in roots in waterlogged soils. Key factors are the root porosity, when this porosity is 30 % or higher, ventilation to the shoot will retain CO_2 at less than half the concentration in the soil. Other important factors are root length and diameter. Acclimation to 10-40 kPa CO_2 in the tissues will depend on tolerance of metabolism to high CO_2-HCO_3^- concentrations and on the ability to lower the set point of the pH of the cytoplasm, thus lowering HCO_3^- at any given CO_2 level .

Huang S, Greenway H, Colmer TD. 2003. Anoxia tolerance in rice seedlings: exogenous glucose improves growth of an anoxia-'intolerant', but not of a -'tolerant', genotype. *Journal of Experimental Botany* **54,** 2363-2373.
Huang S, Ishizawa,K, Greenway H, Colmer TD 2004. Manipulation of ethanol production by exogenous glucose determines rates of solute transport in anoxic rice coleoptiles. *Journal of Experimental Botany* **56,** 2453-2463.

Some research activities at the School of Plant Biology.

David Turner

Maratree Plainsirichai investigated why bananas (*Musa* spp AAA) stay green when ripened at 30˚C but the related plantain (*Musa* spp AAB) does not. The effect seems to be quite early in the series of reactions that lead to the degradation of chlorophyll. Maratree's research was funded by the Government of Thailand. Andreas Neuhaus studied the effect of partial root zone drying on avocado in glasshouse experiments and in the field. Partial root zone drying did not affect either vegetative or reproductive growth in potted plants in the glasshouse even though the soils dried to low levels of water content on the 'dry' side of the root system. There appeared to be no 'signal' associated with root drying. In the field, prolonged root zone drying caused fruit to fall from the tree, but other processes were maintained. Andreas' work was supported by the Australian Avocado Growers Association and Horticulture Australia Limited.

Renuka Shrestha studied the adaptation of lentil (*Lens culinaris*) to drought, especially in the flowering and pod filling stages. Genotypes of different origins respond differently to drought although all seem to retain their seed size while the number of flowers and the number of seed set are strongly affected by water supply. Renuka's work was funded by a John Allright Fellowship through ACIAR with support from CLIMA and CSIRO.

W.A. Herbicide Resistance Initiative (WAHRI)

Director - Prof Stephen Powles spowles@plants.uwa.edu.au

WAHRI is a multi-disciplinary research team focused on the issue of herbicide resistance in Australian weeds and crops. WAHRI, founded in 1998, receives major GRDC funding with much of the research being applied plant science. In addition to Prof. Powles the team consists of four postdoctoral fellows, four PhD students, two research officers and an extension officer. WAHRI activities are divided amongst four programs:

1. Resistance evolution/genetics/modelling.
2. Resistance physiology/biochemistry/molecular genetics.
3. Resistance agronomy, biology and management.
4. Education, extension and outreach activities.

A major research area within WAHRI is understanding the biochemical and molecular basis of evolved herbicide resistance in plants. Physiological, biochemical and molecular studies are underway to elucidate the precise mutations which endow resistance to glyphosate, paraquat and other herbicide families. The impact of these resistance endowing mutations on plant performance (fitness) is evaluated. The biological knowledge generated by research is captured for applied outcomes in Australian cropping through creation and extension of user-friendly population dynamics and bio-economic simulation models.

Identifying mitochondrial DNA transcription factors in *Arabidopsis*

Dr Patrick Finnegan, School of Plant Biology

The nature of the regulatory machinery governing the expression of genes encoded by plant mitochondrial genomes is a fundamental area of mitochondrial biogenesis that continues to be largely neglected. Mitochondria are indispensable to the survival of the plant cell. They are the principle site of energy production and also carry out a wide variety of other essential functions. Mitochondrial function adjusts to accommodate the ever changing requirements of the cell through a dynamic process of mitochondrial biogenesis. The shift to a new dynamic equilibrium is characterised by changes in the expression of genes encoding mitochondrial proteins, the majority of which are encoded in the nucleus. Nevertheless, a small but indispensable set of proteins vital to mitochondrial function are encoded by the mitochondrial genome. Yet we know next to nothing of the machinery regulating the expression of these essential genes. This machinery has a fundamental role in determining cell function and, therefore, plant growth and development.

Dave Thirkettle-Watts and Pearl Tan inspect our laboratory pet.

We are working to identify mitochondrial transcription factors and their target sequences within the mitochondrial genome. We are identifying candidate proteins for transcription factors that bind mitochondrial DNA by data mining the *Arabidopsis* genome and are confirming the subcellular location of the candidate proteins using *in vivo* and *in vitro* mitochondrial import assays. In addition, we are describing the proteome of mitochondrial nucleoids using mass spectroscopy, which will allow us to identify novel transcription factors and other

proteins associated with mitochondrial DNA. Using chromatin immunoprecipitation assays, we will confirm the DNA binding activity of putative transcription factors localised to mitochondria and define their target sequences on the DNA. Through the analysis of transgenic plants, we hope to be able to determine the physiological function of the mitochondrial DNA transcription factors that we identify.

The cell and molecular biology of nutrient transport in symbiotic soybean

Dr. Martha Ludwig, School of Plant Biology & School of Biomedical, Biomolecular & Chemical Sciences

The transport and exchange of ions and nutrients across membranes is of fundamental importance to the survival of organisms. Intracellular symbiotic relationships are excellent systems with which to study these processes as both partners are typically separated from one another by at least one membrane and each is absolutely dependent on the coordination of solute transfer across these barriers. Nitrogen is an essential nutrient for plants; however, it is often the factor that limits plant growth in many soils. Legumes form symbiotic relationships with rhizobia, which convert atmospheric nitrogen into forms of nitrogen that can be used by the plant. In exchange, the plant furnishes the rhizobia with carbon-containing compounds. Many other ions and nutrients are also exchanged between host and symbiont.

Although agriculturalists have exploited this symbiotic relationship for centuries, in many cases, the proteins (transporters) and the mechanisms responsible for nutrient exchange between the bacterial symbionts and their host plants have not been characterised or even identified! We are focussed on the identification of these systems because of the great potential their manipulation offers not only to agriculture but also to animal and human biology as many of the transporters characterised to date have homologues in humans.

We use a combination of biochemical and cell and molecular biological techniques to investigate the structure, function and regulation of transporters involved in the legume-rhizobia symbiosis. We are currently concentrating on the role of recently discovered iron transporters and putative dicarboxylic and amino acid transporters. Our collaborators include David Day (University of Sydney), Steve Tyerman (University of Adelaide) and Brent Kaiser (University of Adelaide).

The Ludwig Lab (left to right) Martha Ludwig, Foteini Tsigkiozoglou, Dave Zeelenberg, Andy Wiszniewski, Helle Christophersen, Joanne Castelli, Suzanne Long, David Angus, Sandra Tanz

Soil Science and Plant Nutrition, Faculty of Natural and Agricultural Sciences

Professor Zed Rengel

Zed's research group comprises 20 people, including 10 PhD students. They work on a range of projects covering soil-plant interactions, abiotic stresses and genotypic differences in nutrient acquisition and utilization. The main philosophy behind a variety of Zed's research interests is studying the interactions between plants and their soil environment in terms of physical, chemical and biological characteristics.

The role of intracellular calcium on the aluminium toxicity syndrome is studied using transgenic tobacco cells as well as Arabidopsis and wheat roots, whereas the new project on the transport of aluminium across the plasma membrane of intact roots will be mainly done on wheat. Ion-selective microelectrodes are being used to study fluxes of Ca, K and H under Al toxicity stress as well as to study nitrogen fluxes in wetland plants to characterize their capacity to clean up eutrophicated water.

Transgenic Arabidopsis plants are being used to study the signaling sequences in the sodium uptake and toxicity. Ecological work is concentrating on species zonation along the gradients of waterlogging and salinity stress in native ecosystems, while the related work under controlled conditions is aimed at deciphering soil-plant interactions underpinning species zonation in the native ecosystems. Pasture grasses and legumes are also being studied. Particular attention is being paid to *Puccinellia ciliata*, a grass species exceptionally well-adapted to waterlogged and saline conditions.

Work in agricultural ecosystems is centered on two themes (i) nutrient cycling from crop residues, and (ii) chemical and biological relationships, including plant-microbe interactions in the rhizosphere of crop genotypes differing in nutrient efficiency. Studied species include wheat, barley, canola, white lupin and others. In addition to plant- and microbe-specific techniques, computer modelling of 3-D root growth and water and nutrient uptake is also used.

Functional Plant Biology

Summer 2005 - 2006 Update

ComBio wrap-up:

It was so nice to be able to see so many of you again at ComBio. Congratulations again to Yong-Ling Ruan for his excellent **Goldacre award** presentation. I hope his daughter Clare also enjoyed her unofficial prize: a ride on a Harley Davidson! I won this at the exhibit, but found that the time allocated to me co-incided with Mike Clearwater's talk, which I really wanted to get to!). So, the ride went to Clare — apparently her first time on a motorbike! Steve Swain's paper from the 2004 Goldacre award will be published in January 2006.

Steve Tyerman and Jennifer Henry presenting Yong-Ling Ruan with his Goldacre medal.

Yong-Ling Ruan waits nervously at the FPB stand for his daughter to return safely from her ride on a Harley Davidson.

Archives:

We are very proud to announce that all back-issues of AjPP have been scanned and posted online, back to Volume 1, Issue 1, 1974. Here is your chance to download your own personal favourites in electronic format. No more making a photocopy of the 15th photocopy of a blurred, creased old reprint of Farquhar *et al.* 1982.

Citation Classics:

Speaking of which, I will be publishing a list of our top ten **Citation Classics** in my January editorial, but here is a sneak peek at the top three. Congratulations to those authors!

1. On the relationship between carbon isotope discrimination and the intercellular carbon dioxide concentration in leaves. GD Farquhar, MH O'Leary and JA Berry **Vol. 9:** 121–137 (1982) **(894 citations to date)**
2. Isotopic composition of plant carbon correlates with water-use efficiency of wheat genotypes GD Farquhar and RA Richards **Vol. 11:** 539–332 (1984) **(587 citations)**
3. Whole-plant responses to salinity R Munns and A Termaat **Vol. 13:** 143–160 (1986) **(360 citations)**

The OSPREY has landed:

Many of you may have already experienced our new Online Submission and Peer-Review system (OSPREY). Like other online journal submission systems, this enables you to submit your manuscripts online, track its progress, and review other people's manuscripts online.

How to submit a manuscript to FPB using OSPREY:
Log in to OSPREY (at http://ospr.publish.csiro.au/publisher/access.view?journalCode=FP) via the FPB website. If you have previously been an author or reviewer for FPB, you are probably already registered in OSPREY. Obtain your password by entering your email address into the 'Forgot Your Password?' box and click 'Send me my password'. You will see a link of the left side 'Submit manuscript'. There are five easy steps:

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How to track your manuscript in OSPREY:
When you log in to OSPREY, you will see the 'Authors Work Area', which consists of two parts: Actions and Tasks. In the 'Actions' section will be a link called 'Submitted Manuscripts Status'. Clicking on this link will take you to a page that shows each submitted manuscript, its version number, its title, the date it was submitted and its current status. You can also change author order, or add or subtract authors. Good luck!

Exciting new web feature: 'Cited by'

'**Cited by'** now appears as a link on any paper on our website, once it has been officially cited in another journal (according to CrossRef). Readers can now view citations to our papers, showing who cited the FPB paper and where. This means that you can now search through the literature using references both backwards and forwards in time, and see which papers are cited as an indicator of the quality we are publishing.

Try looking up your favourite paper on the FPB website and clicking on the right side **'Cited by'** link.

Impact Factor: 'A pox upon the land'?

A very interesting article entitled "The Number That's Devouring Science" was published online in 'The Chronicle' on 14 October 2005. It discusses the origins, use and mis-use of Impact Factors, which the author calls an '**unyielding yardstick for hiring, tenure, and grants**'. It is alarming how powerful this single number has become. The problem is, it's really the only objective way of rating a journal, and so everyone latches on to it. Journal editors spend hours of their time bemoaning or celebrating it, but, until recently, few people discuss its flaws publicly and widely. Now there is increased focus on this number, and it really helps that some of this discussion of its flaws actually comes from those who are *not* disadvantaged by it, such as in a *Nature Biotechnology* editorial earlier this year, rather than just from those 50% of journals with an IF less than 1! While I cannot see the grant review panels and University promotions boards who use it suddenly turning around and saying "Oh, OK, we'll stop using it", or the ISI deciding to stop calculating it, we need to come up with an alternative. In the meantime, the fact that there is plenty of regular and widespread discussion on pros and cons, from parties on all sides of the issue, is really healthy. Anyone using IFs should be aware that there are indeed many flaws, and that it is not the be-all-and-end-all that we once thought it was.

The full article may be read at http://chronicle.com/free/v52/i08/08a01201.htm.

The FPB Best Paper Award:

We are very close to announcing the winner of the 2005 **Best Paper Award**. Stay tuned for the announcement! Competition has been fierce this year, and the ASPS Executive is currently examining the shortlist of papers from eligible ASPS members (10 years or lest post-PhD). The award carries a prize of a personal one-year print+online subscription to **FPB**, and a $250 book voucher from **CSIRO** PUBLISHING. The winning paper will be available as a free download from the FPB website.

Have a safe and enjoyable summer break (for those of you getting out of the lab).

Dr Jennifer Henry
Managing Editor

2004 FPB Best Paper

A locus for sodium exclusion (*Nax1*), a trait for salt tolerance, mapped in durum wheat

***Functional Plant Biology*, 2004, 31, 1105–1114**

Megan Lindsay
Evans Lagudah
Ray Hare
Rana Munns

CSIRO Plant Industry, Canberra
NSW Agriculture, Tamworth
Funded by GRDC

Rana Munns who presented the talk for the best paper in FPB in 2004 at the recent ComBio meeting began with this slide featuring Megan Lindsay who unfortunately could not attend the meeting.

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.

ComBio 2005 Report

By Steve Tyerman

ComBio for ASPS started with an Early Career Forum organised by Tim Colmer from the inspiration of Corrine Jager. Some 70 people turned up at the Plant Research Centre at the Waite and judging by the informal feedback received from students it was a brilliant success despite the inclement weather. Thanks especially to the speakers who really put out, especially Keith Mott who literally just walked of a plane from the US with the cloths he stood up in (his luggage was misplaced). Thanks also to Hans Lambers, Jennifer Henry, Mark Tester, Martha Ludwig, Sally Bell, TJ. Higgins, and Corinne Jager for their inspirational and sometimes very personal expose of their careers.

In the main ComBio meeting I am pleased to report a strong attendance from our membership. There were 149 ASPS members out of the total conference participation if 711. The Society sponsored 22 student travel grants worth $10,611 and for the first time we sponsored the keynote speakers within the symposia if they were from overseas. The lions share of the funds to support these activities comes from the profits made from the ComBio meetings. This year the meeting made a profit of $67,704 (thanks again to Sally Jay) of which ASPS will receive a proportion based on the ratio of our members that attended. So in order for us to sponsor good speakers and fund students, more of us should attend the ComBio meetings. The direct result is a healthier society and more relevant symposia and talks to inspire you.

The ten plant based symposia covered a broad area of endeavour. Whole plant biology was emphasised in order to offset the predominantly molecular and cellular areas covered by the ASBMB. Ecophysiology had a strong showing with two symposia and a tree biology symposia. Also our plenary speakers had much to offer the whole plant area with David Salt (ionomics), Keith Mott (stomatal behaviour), Graham Farquhar (stable isotopes and water use efficiency), Cris Kuhlemeier (plant-pollinator interactions), and Tony Glass (nitrate absorption by plant roots). I wish to thank all the chairs of the symposia for organising great talks, helping with selection of plenary speakers and for doing the chairing of the sessions.

This year we gave greater emphasis to the Teaching Award with a plenary lecture delivered by the winner Dr Martha Ludwig. Despite the Chair incorrectly attributing a sheerer association to Martha, Martha gave an inspirational talk that I am sure invigorated our teaching ideas. We also gave the inaugural Functional Plant Biology Best Paper Award (Dr Megan Lindsay) with the talk

presented by Dr Rana Munns (unfortunately Megan could not come to the conference). Finally the Goldacre lecture was, as usual, excellent, and I congratulate Dr Yong-Ling Ruan both on the award and the presentation. We now look forward to the article to be published in Functional Plant Biology.

The Poster session this year was still organised on a one day only presentation, despite our best efforts with the conference organisation. However, they were well spaced and due to lower numbers I think all presenters got a good degree of exposure. The calibre was excellent and congratulations to the winners of the poster and talk prizes: Derren Plett (Poster), Emily Grace (Poster), Corinne Jager (Poster), Adam Dimech (Poster), Michael Haydon (Talk), and Cameron Playsted (Talk). The abstracts of the prize winning posters and talks are presented below. Special thanks to the judges for the difficult task of picking the winners.

Abstracts of prize winning posters and talks.

ARBUSCULAR MYCORRHIZAL FUNGI INFLUENCE PHOSPHORUS UPTAKE BY BARLEY

Grace E.J.[1, 2], Glassop D.[1, 3], Cotsaftis, O.[2], Tester M.[2], Smith F.A.[1] and Smith S.E.[1]
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Arbuscular mycorrhizal fungi (AMF) occur in symbiosis with land plants in both natural and agricultural ecosystems including commercially grown barley crops in southern Australia. These obligate symbionts are an integral part of the soil:plant continuum. In exchange for photosynthates they supply the host plant with mineral nutrients from the soil. The supply of inorganic phosphorus (Pi) is of particular interest as Pi is a limiting resource in most natural environments and the cost of P-based fertilisers to agriculture will increase with declining availability of phosphate rock reserves. Barley is considered to be a non-responsive AMF host. It exhibits growth depressions when colonised by AMF and often depressions in P uptake relative to control non-mycorrhizal plants. However, experiments with ^{32}P in compartmented pots show that the Pi supply pathway between the AMF and barley is not only functional but also provides a significant proportion of total plant P. As found with numerous other plant species, barley has an AM-inducible P transporter of the PhT1 family, HvPT8. AM colonisation of barley results in decreased expression of the high-affinity P transporters, HvPT1 & HvPT2, which are typically expressed in the root epidermis and root hairs, accompanied by a concurrent increase in transcription of HvPT8 at the symbiotic interface of infected root cortical cells. We suggest that the influence of the AMF on plant Pi transporter expression may regulate the proportion of total plant P acquired via the AM pathway. We report here on the relation between HvPT8 transcript abundance and AMF contribution measured with 32P in compartmented pots.

FUNCTIONAL ANALYSIS OF SODIUM TRANSPORT GENES EXPRESSED WITH BOTH SPATIAL AND TEMPORAL CONTROL IN RICE

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Development of salinity tolerance in crop plants has remained elusive due particularly to its physiological complexity. Two major problems hampering efforts to produce salt-tolerant plants through expression of transgenes include: particular cell-types must respond specifically to salt stress to minimise the amount of Na^+ delivered to the shoot; and, transgenes are typically expressed in plants constitutively, which can be counter-productive to increasing salt tolerance and means that, in low-stress conditions, expensive metabolic processes may be active, thus reducing photosynthate available for grain production. To address these issues, 824 rice (*Oryza sativa* L. cv. Nipponbare) GAL4-GFP enhancer trap lines (Johnson et al., 2005: *Plant J.* **41,** 779-789) were screened with a mild (i.e. agriculturally relevant) salt stress (40 mM NaCl) to identify enhancer elements which are up- or down-regulated by salt stress in specific cell-types.

Expression of *gfp* (and therefore, enhancer element activity) was regulated by salt stress in 18 lines (12 up-regulated, 6 down-regulated). Salt transport transgenes (e.g. *AtSOS1, AtHKT1, AtNHX1, ScNHA1, AtAVP1, ScENA1*) will be fused to the GAL4 UAS (upstream activating sequence), in a modified Gateway destination vector, and transformed into the lines previously identified in the screen, to allow their regulation by salt stress in specific cell-types. In addition, Gateway destination vector constructs have been developed combining the GAL4 UAS with the ethanol-inducible gene expression system to drive inducible cell-specific expression of salt transporter transgenes. Rice lines (not salt-stressed) expressing *gfp* in a specific cell-type will be transformed with this construct, thereby allowing temporal and spatial control of transgenes. Lines expressing salt transport transgenes will be characterized by Na^+ accumulation in the shoots and roots (via flame photometry), $^{22}Na^+$ flux experiments, fresh weight measurements; and lines will be documented by digital photography and confocal microscopy.

GIBBERELLINS, BRASSINOSTEROIDS AND AUXIN: INTERACTIONS AND STEM ELONGATION IN PEA

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Hormone interactions have been a key topic of research over the past few years. Of particular interest are the possible interactions between auxin, gibberellins (GAs) and brassinosteroids (BRs), as these are three major hormones controlling stem elongation. It is now well established that auxin promotes the synthesis of the bioactive GA, GA_1. In addition to this interaction, we have investigated the possible interaction between BRs and the main auxin, indole-3-acetic acid (IAA), by examining the effects of BR deficiency on IAA levels in several tissue types of pea (*Pisum sativum* L.). We found a build up of IAA in the apical bud and a decrease in IAA further down the stem in the BR mutants, *lka* and *lkb*, indicating that a real or perceived BR deficiency causes altered distribution of IAA in the plant. It appears that this altered distribution may be due to altered IAA transport, as the movement of labelled IAA down the stem was altered in BR mutants, in comparison with the wild type. The possible involvement of ethylene in this phenomenon will also be discussed. Finally, we have also studied possible BR/GA interactions by examining the effects of BR deficiency on the GA biosynthesis pathway. Levels of GA_{20}, the immediate precursor to GA_1, were found to be consistently higher in all shoot tissues of the BR mutants. Our results show that even though BRs promote growth in pea, they negatively regulate GA_{20} biosynthesis, although this did not result in consistent changes in the level of GA_1. It appears, therefore, that the BR growth response is not mediated by changes in bioactive GA levels. A proposed model of these hormone interactions in pea stems, and their biological significance, will be discussed.

A MAJOR FACILITATOR SUPERFAMILY TRANSPORTER PLAYS A ROLE IN ZINC HOMEOSTASIS IN ARABIDOPSIS

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Zinc (Zn) is an essential micronutrient required for metabolism in all cells. In higher eukaryotes it is the second most abundant micronutrient after iron, and Zn deficiency is a widespread limitation on crop yields worldwide. Several protein families have been implicated in Zn transport in *Arabidopsis,* including Zrt- Irt-like Proteins (ZIP), CPx P-type ATPases and Cation Diffusion Facilitators (CDF), which are believed to fulfil roles in uptake, vascular translocation and vacuolar sequestration, respectively. In the current study, we have identified a novel mutant of *A. thaliana* that confers sensitivity to elevated Zn. The gene encodes a member of the Major Facilitator Superfamily (MFS), a large class of membrane transporters with a wide range of substrate specificities, but which have not previously been implicated in Zn transport. The protein (here referred to as MFS1) has high similarity to a number of plant homologues with unknown function, but the most similar, characterised proteins are the bacterial drug/proton antiporters, which include the metal-tetracycline transporter, TetA(B), from *E. coli.* Mutants of *MFS1* show decreased fresh weight on elevated Zn, and elemental analysis shows an apparent increase in shoot Zn content (g/DW) but no difference in total Zn per plant. A promoter-GUS reporter fusion shows widespread expression with highest expression in developing leaves, particularly in cells at the base of trichomes. GUS expression is also strongly induced throughout the entire plant under elevated Zn. We believe MFS1 fulfils an essential role in Zn tolerance in *A. thaliana,* possibly by sequestering a Zn-chelate. Current experiments include determination of membrane localisation using GFP fusions and epitope tagging, gene expression analyses using RT-PCR and identification of MFS1 substrate by LC/MS of mutants and transgenic lines.

GENETIC DIVERSITY OF GYMEA LILY (DORYANTHES EXCELSA CORREA) USING RAPD MARKERS

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The monocotyledonous species *Doryanthes excelsa* (Doryanthaceæ) or "Gymea Lily" is indigenous to the central coast of New South Wales, Australia and has considerable potential as an export cut-flower crop. The illegal collection of floral and seed material from wild populations for the cut-flower and seed industries poses an additional threat on certain populations that have already been reduced in size by land clearing. As an initial step towards the conservation of this species, immature and semi-chlorophyllous leaf samples were collected from nine population centres across the natural distribution range. Random amplified polymorphic DNA (RAPD) primers were used to assess genetic diversity of plants within and between populations. Ten primers were used in this study which produced 103 amplified fragments across the entire data set. A dendogram constructed from the genetic similarity values showed four clusters comprising of three individual populations (Sommersby, Kremnos Creek and Newfoundland State Forest) with the six remaining populations clustering together. This may indicate that sub-populations have evolved by adaptation to changing environments through localised geographical isolation.

THE ROLE OF SPECIALISED DAUCIFORM ROOTS AND HIGH AFFINITY TRANSPORTERS IN THE UPTAKE OF PHOSPHORUS BY CAUSTIS BLAKEI (CYPERACEAE)

Playsted C.W.S.[1], Johnston M.E.[1], Ramage C.M.[2], Edwards D.G.[3], Hamilton S.[4] and Lambers H.[5]
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Members of the Cyperaceae are common in the phosphorus (P) limited soils of many Australian plant communities, despite their mostly non-mycorrhizal nature. We sought to identify some of the physiological adaptations contributing to the enhanced P acquisition of the sedge *Caustis blakei* Kük, and also to characterise its extreme sensitivity to increased P supply. Observed low-P acclimations include an increased root to shoot ratio and the formation of specialised dauciform roots at very low solution P concentrations (≤1 µM). After 20 weeks of growth at 0.01, 0.1, 1.0 and 10 µM solution P, the percentage of dauciform roots to the entire root mass was greatest (37%) in the lowest P solution (0.01 µM) and declined with increasing P supply. Dauciform roots posses a similar morphology to the cluster roots of Proteaceae which aid the uptake of sparingly available soil P. The low-P induction of dauciform roots in *Caustis* suggests they may be involved in mobilising adsorbed soil P, which was supported by the increased quantity of carboxylates found in dauciform root exudates. Citrate was the major carboxylate present reaching a peak exudation rate (0.3 µmole g^{-1} FW h^{-1}) in mature dauciform roots. Malonate was the dominant internal carboxylate present, with the highest concentration (17 µmole g^{-1} FW) in young dauciform roots. Under increased solution P concentrations (≥ 10 µM) dauciform roots were absent, and the plants showed typical P-toxicity symptoms. We hypothesise that the down-regulation of high-affinity P transporters in roots may be impaired in *Caustis* , leading to the accumulation of P in the shoot to toxic levels. We have cloned two putative high-affinity P transporter genes, CPT1 and CPT2 from P-starved roots. The expression patterns of CPT1 and CPT2 in roots was assessed using Real Time PCR, and the results will be discussed.

Annals of Botany Lecture - One Highlight of ComBio2005

By Tim Colmer

Keith Mott (Utah State University) presented the 2005 Annals of Botany Lecture at ComBio. His talk "Emergent behavior and information processing by stomata" was a highlight of the Conference. Keith presented the latest data and theories on how stomates might interact over short distances to form "locally-connected networks". Such interactions between/amongst stomates may be vital to optimise gas exchange at the whole-leaf (and therefore whole-plant) levels. This aspect of stomatal physiology was compared with principles of information processing by artificial networks of computers. The lecture dealt with complex topics, but was presented in a very clear (and entertaining) way; all reflecting on the high quality of the research presented. The Annals of Botany are thanked for their continued support of Plant Science in Australia by sponsoring these lectures at ComBio, and we thank Keith Mott for his excellent presentation at ComBio2005.

2005 ASPS Workshop for Postgraduate and Early-Career Researchers

report from Tim Colmer

As part of ComBio 2005, ASPS organised a half-day workshop for postgraduates and early-career researchers. The idea for a workshop came from Corinne Jager (Postgraduate representative on the ASPS Council) and it was organised by Tim Colmer (Education representative on ASPS Council). John Patrick (ASPS Secretary) and Steve Tyerman (ASPS President) are also thanked for their help with the event, as is the University of Adelaide for providing an excellent venue, and the Wine and Horticulture Group for providing refreshments during the afternoon.

The programme consisted of three themes. Theme 1 was “Tips for publishing”, with excellent presentations given by Hans Lambers (University of WA; Editor of Plant & Soil) and Keith Mott (Utah State University; Editor of Plant, Cell & Environment). The presentations covered approaches to writing a good paper, as well as tips for dealing with comments from reviewers.

Theme 2 was “Career paths: case studies”. The four speakers were selected to represent diversity in career paths: Jennifer Henry (Editor, Functional Plant Biology), Mark Tester (University of Adelaide), Martha Ludwig (University of WA), Sally Bell (The Australian Wine Research Institute). The four presentations were very entertaining, highlighted the diversity of opportunities available to young scientists, and also had some common messages: focus on what stimulates and interests you, do it to your best ability, even what might initially seem like a “less than ideal opportunity” can often lead to “bigger and better things”, contribute to your group (e.g. attend and present seminars, get involved in Conferences), establish and use your networks (e.g. within ASPS), and PUBLISH your work in quality journals.

The third and final Theme was “Tips for job applications and interviews”. TJ Higgins (CSIRO) provided valuable tips on preparing applications and Steve Tyerman (University of Adelaide) tips for interviews. The observations from these experienced scientists, both frequently involved in selection processes, will undoubtedly prove very useful to job-seekers.

To wrap up the day, Corinne Jager (University of Tasmania) talked about the challenges faced by new graduates “The view from the 'hot seat'”. A key message was to get involved with ASPS, contribute to meetings and seminars, talk to the more established scientists in ASPS, and most importantly PUBLISH your work in quality journals. Steve Tyerman (President of ASPS) then led a stimulating open floor discussion at the end of the day.

ASPS plans to organise a similar workshop on the day prior to ComBio 2006 in Brisbane. Please send your suggestions of themes or speakers to Dr. Tim Colmer (tdcolmer@cyllene.uwa.edu.au).

Fund-Raising Raffle for the R.N. Robertson Travelling Fellowship.

By Peter Ryan

The recent launch of the R.N. Robertson Fellowship is an exciting development for plant science in Australia. R.N."Bob"Robertson was renowned for his stimulation of undergraduate and postgraduate students and the fellowship established in his name will encourage young plant scientists to travel and participate in a research outside their immediate disciplines. The Fellowship is supported by donations from members, a large contribution from ASPS, and royalties from the sale of our society's own textbook "Plants in Action".

This year we ran a raffle at ComBio which not only raised $451 but highlighted this initiative to our ASPS members. Winners were drawn out of a hat during the ASPS annual dinner by the managing Editor of Functional Plant Biology, Jennifer Henry. A selection of fantastic prizes included autographed photographs of Professor Peter Doherty, winner of the 1996 Nobel Prize for Medicine and mentor of life-science research in Australia, wine from some of the best cool-climate wineries in Australia including the acclaimed Clonakilla (www.clonakilla.com.au), Helms (www.helmwines.com.au) and Barton Estate (www.bartonestate.com.au) wineries, and selected wines from the University of Adelaide's own School of Viticulture and Oenology.

First prize winner was Bostjan Kobe (a ring-in from the ASBMB who came to the ASPS dinner with a friend and bought one ticket !), second place was won by this years J.G. Wood Lecturer, Graham Farquhar (ANU), and other winners included Jennifer Henry (but wasn't she the one drawing out the winning tickets ?), Rana Munns and Rosemary White (CSIRO Canberra). The last two winners deserve a special mention because, not only did Rana and Rosemary agree to help me cart much of the donated wine from Canberra to Adelaide in their luggage, but upon winning wine in the raffle, they had to carry it back again!

ASPS acknowledges the generosity of Peter Doherty as well as the three wineries for supporting plant science via the R.N. Robertson Fellowship. We were made aware that all three wine producers have direct connections with plant research in Australia. John Kirk (Clonakilla) was a research scientist and Assistant Chief at CSIRO Plant Industry, Ken Helm was a technical officer with CSIRO Entomology and Bob Furbank (Barton Estate) is currently a research scientist at CSIRO Plant Industry. Many thanks to you all.

Details and application forms for the R.N. Robertson Fellowship are available on the ASPS Website (www.plantsci.org.au).

A happy Bostjan Kobe can't believe his luck after winning first place in the R.N. Robertson Fellowship raffle. Bostjan's prizes include an autographed photograph of Peter Doherty, his choice of 6 bottles of fine wines from Canberra and Adelaide and several pieces of fruit. The fruit will enable Bostjan to recreate Doherty's Nobel prize winning experiments just as Peter himself did so elegantly on the ABC television show "Enough Rope" hosted by Andrew Denton.

IP Roots & Branches

"Using the Patent System: First Steps"

Using the patent system for the first time, or using it infrequently, can be a challenging undertaking for the uninitiated. In this article, I will try to explain how the Australian patent system works and what is required of the user from the Inventor or Applicant's point of view, as a bench scientist working in Australia.

A patent is one way of establishing a legally defined and enforceable claim to a monopoly right for a given piece of technology. The monopoly right is granted by the Commonwealth of Australia and is prescribed in the *Patents Act.*

A key condition, prior to securing such a profound right, is for the patent Applicants to demonstrate that their invention is new and inventive. The novelty and inventiveness of any patent application is judged against the prior art at the time the invention is made. What is known, previously filed as a patent or published in some form is collectively known as "prior art". Accordingly, a vital first step for any Applicants is to formally establish a priority date for their invention against which the prior art can be assessed.

The priority date for an invention is formally established by filing a patent application at the Patent Office. In the case of Australia, a provisional patent can be filed at the Australian Patent Office. International Treaties ensure that such filings made with the Australian Patent Office are accorded identical priority rights in most other countries, providing filings in other countries are made within 12 months of the priority date. So, an applicant only has to file one application in one country in the first instance.

As the provisional patent application will formally establish what the inventor has invented and what can be claimed; and the disclosures in the provisional will be used to compare what has been invented with the prior art, great care needs to be taken when drafting a provisional patent specification. In the first place, an invention must have been made. An invention is not just an idea, or a proposal or a wish list. An invention is a creative solution to a problem recognised by the inventor where the exercise of some inventive faculty has allowed the inventor to solve the problem in a manner that is not obvious. This means that the inventor should have actually worked the invention; or at the very least, be able to fully describe the invention in terms that will allow a reader to reproduce the invention. This is the central philosophy of the patent system; that the Commonwealth will grant a monopoly in exchange for the inventor ultimately placing the invention in the public domain.

When an inventor is at this stage they may be ready to file a provisional patent application. Once a provisional patent application is filed a 12 month clock begins to tick. The provisional patent must be followed by a complete application within that time, if the priority date set by the provisional is to be used.

At this stage, let us clarify the relationship between a provisional patent specification and a complete patent specification. Whilst the provisional patent is a vital filing for establishing a priority date, the provisional patent specification is, as the name suggests, a provisional document

only. A provisional patent only serves as a legal document establishing priority; it will be filed at the Patent Office, it will not mature into a granted patent and in all likelihood nobody will ever look at it again. The "Complete" application, filed within 12 months of the provisional will, however, mature into a granted patent, all going well.

The "Complete" specification, therefore, must be based on the provisional; but can (and should) include any relevant further data and work that has occurred in the 12 months since the provisional filing. Often, a provisional specification will include some speculation of what the inventor expects the technology to provide in the future. Care must, of course, be taken to ensure that any unsupported disclosures made in the provisional can and are fully supported in the complete specification. If proper basis for all the disclosures made in the provisional application cannot be supported in the complete specification, it may not be possible for the claims to cover this subject matter. Even so, the provisional specification will become published shortly after the complete application is filed. As such, unsupported disclosures in the provisional and/or complete specification may thereby prior publish any subsequent attempts by the inventor to file patents and claim this subject matter when supporting data finally becomes available.

LESSONS TO BE LEARNED

A provisional patent should be filed before any disclosure is made of the technology.

The provisional patent must fully describe at least one embodiment of the invention.

The provisional patent may include some speculation for future embodiments of the invention; but any disclosures need to be supportable in 12 months when a complete application falls due for filing. If you are not reasonably confident in finishing the additional work required to fully support all disclosures made by the provisional, the following options may be available:

a. If there has been no disclosure of the work, the provisional can be refiled. This will re-set the priority date; but, will also re-set the 12 month clock.
b. File two provisional applications at the start. One will be restricted to the finished work; the other will include the speculative aspects of the work. If the speculative work is finished with the 12 month time, the provisional including that work can be used as the basis for priority for the complete application which will include that work. Alternatively, if the speculative work is not finished, only the provisional including the finished work will be used as the basis for priority. The other provisional will not be used and will, therefore, lapse without being published.

A complete specification can, and should, closely reflect any provisional specification on which it relies for priority. But, a complete specification should be carefully drafted as a "rethink" of the provisional so as to include any additional data, improvements and developments, and ensure all embodiments and claims are fully supported by adequate data and description.

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Did you know….?

- ***Cell Biology news.*** Proceedings and selected papers from the 4th International Congress on Allelopathy that took place 21-26 August at Charles Sturt University, Wagga Wagga, NSW have just gone on-line at:
  http://www.regional.org.au/au/allelopathy/2005/

- ***Congratulations***. Congratulations go to Harvey Millar who was awarded the Prime Minister's Prize for Life Science for 2005 for his work on plant mitochondria and proteomics.

- ***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***.

- ***RN Robertson Travelling Fellowship.*** Applications close for the inaugural RN Robertson Travelling Fellowship close **January 30 2006**. For further details see pp6-8 or go to: *http://www.plantsci.org.au* and take the *AWARD* link where guidelines and application forms can be found

- ***Postgraduate section in Phytogen***. A Postgraduate section will be established in Phytogen where student members are encouraged to publish summaries of their PhD theses. The summaries can be submitted once the thesis has been approved.

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

- ***Goldacre and Teaching Awards***. Nominations for these prestigious awards will close on April 14, 2006. Please give thought to nominating a deserving recipient. Guidelines and selection criteria are outlined in the relevant web pages (click the button 'Awards').

- ***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

Alternative splicing insights

Penny Smith's paper 'Alternative splicing of the Vupur3 transcript in cowpea produces multiple mRNA species with a single protein product that is present in both plastids and mitochondria' (*FPB* **32**: 683-693) discusses nodules of tropical legumes, which are ideal for studying the purine biosynthesis pathway, for determining aspects of its subcellular localization and for the isolation of pathway enzymes and the genes encoding them. The paper details work characterising the alternative splicing of the transcript of pur3 from cowpea, and the localisation of its protein product. The authors show that several different mRNAs are produced from this gene, and correct previous work on the soybean homologue of this gene, to suggest that the different transcripts seen may not have originated from different genes.

Flavoursome hexose transport

Stephen Dibley's work on sugar accumulation in tomato, 'Temporal and spatial expression of hexose transporters in developing tomato (*Lycopersicon esculentum*) fruit' (*FPB* **32**: 777-785) discusses a key way to enhance flavour for the fresh food market, and soluble solid levels for processing. In this paper, hexose accumulation was compared with gene expression and protein levels of hexose transporters in developing tomato fruit. The authors demonstrate that transporter protein levels correlate strongly with rates of hexose accumulation. Based on their temporal and spatial expression patterns, two hexose transporters (LeHT3 and LeHT1) are suggested to be responsible for hexose accumulation.

Aging by gas responses

Extending a bough to our kiwi colleagues, Nigel Gapper's paper 'Senescence-associated down-regulation of 1-aminocyclopropane-1-carboxylate (ACC) oxidase delays harvest-induced senescence in broccoli' (*FPB* **32**: 891-901) is a beauty. Although the effects of antisense expression of ethylene biosynthetic genes have been described in several crop species previously, this paper provides new information about changes in expression of sugar metabolism genes. The paper describes the characterisation of transgenic broccoli plants altered for ethylene status following harvest. The authors delayed post-harvest senescence in transgenic broccoli using an anti-sense ACO construct. Plants showed a reduction in ethylene biosynthesis and expression of a number of senescence-associated genes, normally associated with post-harvest senescence, confirming that ethylene is a key regulator in this process in harvested broccoli. The work helps our understanding of the role of ethylene to promote senescence.

Gibberellin receptor

This has been a big year for discovering plant hormone receptors. Following on from brassinosteroid and auxin receptor discoveries (see Phytogen 7.1 and 7.2), an intracellular soluble gibberellin (GA) receptor has been identified in rice by Ueguchi-Tanaka *et al.* 2005 (*Nature* **437**: 693-68). The authors isolated a new GA-insensitive dwarf mutant, *gid1*. Recombinant GID1 bound GA with a high affinity. When GA binds GID1, the complex interacts with SLR1 (one of the DELLA genes bound to GA inducible transcription factors). Consequently, SLR1 is degraded through the SCF^{GID2} proteasome system and the transcription factors are free to activate GA-inducible genes. This is very similar to the mechanisms identified as part of the auxin receptor which also involves activation of proteasome pathways. We should look out for more instances of small organic molecules (hormones) modulating protein-protein interactions.

RNA – a flowering signal

For over 50 years it has been known that flowering is stimulated in the shoot apex by a mysterious mobile signal, “florigen” produced in leaves in response to daylength or other conditions that promote flowering. Arabidopsis has been used to unravel this process. Last year, Valverde et al 2004 (*Science* **303**: 1003) showed that the transcription factor, *CONSTANS* (*CO*) accumulates in long days CO activates expression of Flowering Locus T (FT) in leaves but not shoots. FT in turn activates floral identity genes in the apex like *APETALA1* (*APA1*). Abe et al 2005 (*Science* **309**: 1052-56) and Wigge et al 2005 (*Science* **309**: 1056-) examined the expression of a bZIP transcription factor, FD, that is mainly expressed in the shoot apex. They showed that FT interacts with FD and that this complex then activates genes leading to induction of flowering. These studies both implicate FT (produced in the leaf and acting in the shoot apex) as florigen or part thereof. The real twist in the tale is that it is the transcript (mRNA) of FT that moves from the leaf to the shoot apex. This was elegantly demonstrated by Huang *et al* 2005 (*Science* **309**: 1694-96)

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