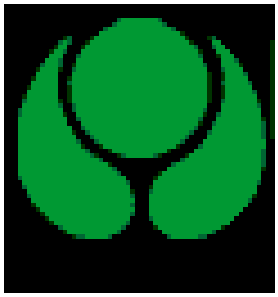


PHYTOGEN

A NEWSLETTER FOR AUSTRALIAN PLANT SCIENTISTS

Volume 4 Number 1
March 2002

PHYTOGEN

Volume 4: Number 1 2002

INSIDE THIS ISSUE

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

Editors' Corner....

getting down to the grass roots

Greetings and a Happy New Year to you all. Hard to believe that it is already March 2002.

The first Phytogen for this year is packed full of varying articles from across not only Australia but also the globe. This edition's 'State of Affairs' focuses on research in the Far West – Western Australia. Meanwhile, the Autumn update for FPB has been sent in by Jennifer McCutchan. It is also pleasing to see a report from one of the discipline representatives. We aim to improve on this in future issues when we begin to hound the new representatives for articles – that is, the next issue. You have all been given notice! The Twigs and Branches section has a range of small articles whereby you can obtain further information using the relevant links if interested. In the next edition, we will have a complete wrap of ComBio 2002, which is being held in Sydney later this year.

Students!

Do you have any burning issues that you have wanted to discuss about the Society? Do you have any general questions that you need answers to about the Society? If so, e-mail your new student representatives (Matthew Searson and Sally Box) to let them know about it.

Any suggestions for improving Phytogen are always welcome.

A big thank-you to all the people who have contributed so far while we have been Editors. We understand that it does take time to write an article for the Newsletter but without your support, there would be no Newsletter. We encourage everybody to contribute, even if it is only a snippet of information!

Hope you all have a safe and enjoyable Easter vacation.

Until next time…. *Jason and Amanda.*

Secretary's Report

The two main items to report are:

- The name change of the society to Australian Society of Plant Scientists, which went through smoothly. Sorry about the delay in changing the name on the web site, but we could not risk 'trading' under the new name until it was officially registered.

- The new administrative arrangements. Jeremy Foster, from the University of Western Australia, will be managing the database and the accounts of the society. He will be able to answer all queries on membership status, and will update the Directory of Members on the web site on a regular basis.

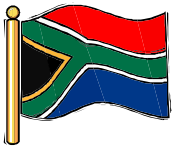
Soon you will be receiving the registration booklet for Combio2002, in Sydney. Martha Ludwig and Brian Atwell have been largely responsible for the arrangements, and we are all very grateful to them for the time and effort they have put into organising what promises to be the best ComBio to date.

The website is expanding on a regular basis. The Webmaster is happy to insert news of job positions or coming conferences (as well as any other relevant material) and is updating the site about twice a week. Send items you want posted on the site to the Secretary. The link with Functional Plant Biology is working well and we hope to have more interaction with the journal in the future.

We are looking for new ideas about the functions of the society and ways to increase the communications between society members. If you have ideas or suggestions, please e-mail anyone on the board, any one of the discipline representatives or the editors of the Newsletter for dissemination and discussion.

Rana Munns
Hon Secretary, ASPS

To get the ball rolling, the Editors would like to start the discussion by asking what the Executive now plans to do with additional monies that are obtained through the society now that Phytogen is purely electronic and is saving in excess of $8000 per annum. One possibility is that we could have our own annual prize for best piece of PhD thesis research submitted and accepted to a journal. Similarly, for post-doctoral fellows of no more than 3 years experience post-PhD. These could be awarded at the annual ComBio along with the Teaching Award and the Goldacre Award.



Plasmodesma Report: 2001: Cape Town, South Africa

Rosemary White, CSIRO Plant Industry, Canberra, ACT

In what seemed like the wettest week of the year, plasmodesmata enthusiasts met in Cape Town for the first Plasmodesma conference in the Southern hemisphere. These meetings are held every 4 to 5 years, the first being in York in 1987, followed by Wageningen in 1991 and Zichron Yakov (near Tel Aviv) in 1996. This year's meeting was held in the Graduate School of Business, University of Cape Town, next to our accommodation in the Breakwater Lodge (a former prison!). The interests of the author, bias the following brief report, with a fuller report having been published in the January 2002 issue of Plant Cell (Cilia et al., *Plant Cell* **14**:7-10). The meeting began with a session on plasmodesma structure and development, chaired by our indefatigable host, Ted Botha (Rhodes University), which continued in a later session chaired by co-host Ed Rybicki (University of Cape Town). We have known for many years that plasmodesmata structure and molecular exclusion limit may change during development, but it is difficult to correlate these structural and functional changes. Alison Roberts (Scottish Crop Research Institute) reported a very elegant study showing that sink-source transition in tobacco leaves is marked by branching of plasmodesmata and reduction in molecular exclusion limit, and that branching is initiated in different cell layers at different times. Nevertheless, it has generally been assumed that despite their variety in structure and transport properties, all plasmodesmata are under similar regulatory controls. A predominant theme in the early sessions, introduced by Bob Turgeon (Cornell University), and continued throughout the meeting, was that plasmodesmata from different tissues, and especially those at different stages of development, may respond in diverse ways to metabolic and other regulators.

The major gap in our knowledge is that almost nothing is known about plasmodesma-specific proteins, some of which may be the target of regulatory molecules. Leila Blackman and Christine Faulkner (University of Sydney) outlined a biochemical/proteomics approach to identifying these proteins from the alga, *Chara*, and discussed preliminary characterisation of some of them. Several other groups are approaching this problem using cDNA-GFP fusion libraries (David Ehrhardt, Carnegie Institution, Stanford University), protein-trafficking mutants (Michele Cilia and David Jackson, Cold Spring Harbor Laboratory) or proteomics of higher plant cells (Andy Maule, John Innes Centre). Hopefully, these new approaches will speed up the slow progress to date. Subsequent sessions updated investigations into plasmodesma function using virus movement proteins and examined further their role in macromolecular trafficking, especially movement of GFP-tagged proteins. The trafficking theme continued with talks on cell-to-cell movement of mRNA, thought to be essential for coordination of tissue and organ development. Also discussed was an exciting corollary to RNA movement; the symplastic transmission of gene silencing, which may be part of a plant defence mechanism against viruses that spread by RNA trafficking.

Aart van Bel (Justus-Liebig-Universität) led the sessions on long-distance transport via phloem, with particular focus on symplastic control of sieve element function by companion cells. He and Michael Knoblauch showed beautiful images and videos of sieve tubes in action, demonstrating their very rapid responses to various stimuli. Bob Turgeon and Alex Schulz (Royal Veterinary and Agricultural University, Copenhagen) elaborated on phloem loading and the role of phloem proteins, respectively. An emerging theme is that phloem-mobile components may have a critical role in development since some mRNAs and proteins found in phloem are graft-transmissible from stock to scion.

The meeting finished with a lively general discussion session focusing on future research directions, and confirmed that the next meeting

would be in the USA (tentative organisers Dave Jackson and Bob Turgeon). Many fundamental questions remain about plasmodesma composition, development and regulation, and the diversity of new approaches to this problem ensures the next meeting will be as interesting as this one.

Australian Plant Cell Development Group (APCDG) Meeting

This meeting was held from November 23-25 at Glenfalloch, a property near Holbrook, NSW, which has bunkhouse-style accommodation with communal kitchen and dining room suitable for such small group meetings. The APCDG has been meeting for over a decade at various locations such as Holbrook, Charlotte Pass and Thredbo, which are equally accessible to participants from both Victoria and New South Wales. The meetings are meant to encourage better communication between various research groups and their students in an informal atmosphere.

Last year's meeting (2001) was organized by John Harper, who recently joined the faculty at Charles Sturt University in Wagga Wagga, with critical assistance primarily provided by his former colleagues at the University of Sydney (food supplies!). There were 25 speakers, mainly graduate students and postdoctoral fellows, representing Charles Sturt University, the Australian National University, Deakin University, the Universities of Sydney and New South Wales, and CSIRO (Plant Industry). Although the majority of talks focused on cell and molecular biology, the meeting covered a diverse range of topics not strictly limited to plant cellular/developmental research, including biological weed control, proteomics, and research on *Dictyostelium*, various fungi and Oomycetes. Of particular interest to cell biologists were talks on centrin function and diversity, organelle division, the role of proline in osmoregulation and of myosin in cell division, vacuole formation and morphology, and a group of talks dealing either with aspects of microtubule organization, dynamics and microtubule-associated proteins (for example: phospholipase D, MOR1), or cell-to-cell communication and transport in plants. Talks were nominally 5 or 10 minutes in length, with plenty of time for discussion after each one. Despite the rustic facilities, laptops and projectors for PowerPoint, slides or overheads were available.

The talks were held Friday night, Saturday and on Sunday morning in the airy dining room. As talks were informal, we sat around the tables in an informal, relaxed atmosphere that was particularly appreciated by the students, and which certainly resulted in a higher ratio of questions and discussion per talk than observed in many sessions of the recent ComBio meeting. The meeting fulfilled its function, since participants exchanged useful information on materials and methods, discussed alternative interpretations of results, provided information on new publications, talked about science policy and funding and arranged for seminars and visits.

The meeting was self-catered (apart from the excellent Saturday night BBQ provided by David Murdoch and family of Glenfalloch), and there was no shortage of good food and drink. The Farrer Centre at the University provided wine and a large platter of tasty and innovative cheeses, all products of Charles Sturt University. The meeting ended with a leisurely canoe trip along the upper Murray River on Sunday afternoon. Due to the success of this year's venture, it was agreed that next year's meeting of the APCDG would also be held at Glenfalloch, to be organized by Geoff Hyde (Mycorrhizal Research Group, University of New South Wales).

***Moira Galway**, Associate Professor, St Francis Xavier University, Canada*
Visiting Fellow (Geoff Wasteneys' lab)
Plant Cell Biology Group, RSBS, ANU.

DISCIPLINE PERSPECTIVES

Genetics & Molecular Biology

Submitted by Roger Parish

Molecular Genetics of Flower Morphogenesis

Genes that control developmental decisions in plant morphogenesis are now accessible in *Arabidopsis thaliana*. David Smyth's laboratory has identified such genes through their mutant disruptions to floral organ development. Following cloning of the genes by DNA tagging or chromosome walking, they have identified five new transcription factor genes. Each gene is the member of a family, covering the bHLH, AP2, YABBY, trihelix and WRKY families (the last four being plant-specific). The lab is focusing on the bHLH gene that is involved in carpel and transmitting tract development, and the trihelix gene that controls the initiation, orientation and growth of petals. Their expression profiles, their interactions with other genes, and their molecular mechanisms of action are now being deduced.

Sexually Confused Oil Palm

Bernie Carroll and Peter Gresshoff (University of Queensland) have signed a 3 year, $808,000 research contract with the Malaysian Biotech and Oil palm company 'Guthrie Biotech' to investigate molecular markers associated with sex determination in oil palm flowers. It appears that tissue culture confuses the palm's genome when it comes to sex determination producing androgynous, mantled and hermaphroditic flowers. We suspect that epigenetic changes such as DNA methylation may be active.

GSTs: they aren't all bad…

Plants detoxify a range of xenobiotic molecules they come in contact with using a three step process involving activation by cytochrome P450s, conjugation by GSTs (glutathione-S-transferases) and removal from the cytosol by tonoplast ABC transporters. In the model plant *Arabidopsis*, genome sequencing has revealed that this apparently simple three step process is complicated by the existence of large gene families for each enzyme: 273, 47 and 51 members respectively. Harvey Millar and Karam Singh (Plant Molecular Biology Group, University of Western Australia & CSIRO Plant Industry, WA) are using a variety of molecular approaches to better understand the regulation of expression of the GST family in order to determine the role of individual members in xenobiotic detoxification and responses to defense signals and oxidative stress. Using GST promotor:LUC constructs in *Arabidopsis* they are screening for mutants in upstream signaling pathways. Using microarrays and proteomics they are following transcription, translation, post-translational modification and protein targeting of GST gene products in response to stress stimuli and in different mutant backgrounds. This detailed road map provides information that they hope will be rapidly applicable gene-for-gene to increasing herbicide tolerance in *Brassica* crops such as canola and also in detecting and managing multi-herbicide resistance in major *Brassica* weeds such as wild radish, wild turnip and wild mustard.

And at CSIRO Plant Industry

Gene Silencing

Peter Waterhouse's group has exploited the mechanisms that appear to be important for plant defence against viruses to develop very efficient methods for gene silencing. A gene is introduced in both the forward and reverse orientation, separated by an intron, together with a promoter and a terminator. When RNA is transcribed from such a construct, RNA is made and sequences that are located in the 'hairpin' target

the same sequences in the genome. Peter's group has used this for knocking out many endogenous genes for viral immunity including protection of wheat and barley plants from the Barley Yellow Dwarf Virus.

Vernalisation

Research at Plant Industry has shown that the *FLC* gene was a quantitative repressor of flowering, which also mediated vernalisation. Candice Sheldon has identified the sequences in the *FLC* gene involved in responding to vernalisation. These include sequences in the promoter and in the large first intron. It appears from research conducted at the John Innes Centre that vernalisation has two phases, an initial down regulation of *FLC* and then maintenance of the lower level of *FLC*. Candice has shown that the sequences responsible for these two processes can be separated.

Genomics

Plant Industry has set up a facility for plant genomics. Our microarray technology is well established and we are identifying genes that are up and down regulated in a number of biological processes and mutants, mainly in *Arabidopsis*. We are also developing microarrays for other crop species.

Haemoglobin

We have undertaken a long-term study on plant haemoglobins. We have now isolated three classes of haemoglobin genes in plants each with different patterns of expression. Haemoglobin 3, the most recently discovered haemoglobin, appears to be expressed in the phloem. Haemoglobin 1, which is switched on by low oxygen conditions, can help protect against anaerobic stress.

The Complexities of Seed & Fruit Formation

In nature, there is a spectrum of methods by which plants reproduce themselves: mostly by seed but also by vegetative propagation, flowers that form fruit despite not being fertilized and so on. So many different methods have probably evolved to ensure the survival of species, but it also opens up possibilities to modify plants to change their characteristics. For example, as shown by the popularity of navel oranges and sultana grapes (both naturally occurring mutants), seedlessness is popular in fruit. Anna Koltunow's team is targeting genes that produce this phenomenon in model plants for transformation into citrus, and they have already shown that it is possible to put selected genes into West Indian limes and produce fruit with fewer and smaller seeds.

In the next Phytogen edition, 'State of Affairs' will focus on South Australia. Hopefully we will have a more detailed report about this research from the team at CSIRO-PI, Horticulture (Eds.).

RESEARCH AT THE PLANT CELL BIOLOGY RESEARCH CENTRE

THE UNIVERSITY OF MELBOURNE

By *Ed Newbigin* (edwardjn@unimelb.edu.au) & *Tony Bacic* (abacic@unimelb.edu.au)

The Plant Cell Biology Research Centre (PCBRC) is housed in the School of Botany at the University of Melbourne and its main participants are Tony Bacic (Director), Ed Newbigin (Deputy-Director), Barbara Howlett and Geoff McFadden. A private biotechnology company, Hexima, is also a PCBRC associate. Currently the PCBRC has around 33 professional and technical staff, 23 PhD students and 6 Honours students. The annual budget of over $2 million comes from grants awarded by the ARC, the GRDC, CRC program, the Howard Hughes Medical Institute, the Wellcome Trust, NH&MRC and other industry and government agencies. The staff are experts in cell and molecular biology, biotechnology and structural biology, proteomics and glycobiology, and researchers have access to state-of-the-art analytical facilities (gene and protein sequencers, GC/MS, ESI-MS, MALDI-TOF-MS) and microscopes (light, fluorescence and EM).

The research interests of the PCBRC are many and varied and cover fields as diverse as plant reproduction, human parasitology and the extraction of valuable products from agricultural wastes. One of the larger research groups is part of the CRC for Bioproducts, a centre of biotechnological innovation that uses fundamental knowledge to underpin commercial applications and thereby create long-term economic benefits for Australia. Another group is part of a functional genomics program that started in 2000. This research is conducted in collaboration with the research groups lead by Professors Geoff Fincher and Peter Langridge at the Department of Plant Sciences, University of Adelaide, with funding coming from the GRDC and the Universities of Adelaide and Melbourne. The research aims to use the emerging tools and technologies known collectively as 'genomics' to examine biological processes relevant to Australian cereal industries, such as the control of early seedling growth and vigour, and grain quality. Cell walls are being studied because of their importance to plant development and because walls are key components in the resistance of plants to pathogens, in human nutrition, and in determining many of the important quality characters of cereal grains. A complete list of all PCBRC projects and research groups is on our webpage (http://www.plantcell.unimelb.edu.au/). Check it out!

Picking highlights from the recent past is difficult, given the PCBRC's size and diverse interests, so hopefully the one or two examples we've chosen to mention will satisfy the curious. The PCBRC is perhaps best known for its research on self-incompatibility in the Solanaceae, the family of plants that includes tomato, tobacco and pepper. This project was started by Adrienne Clarke many years ago and is now directed by Ed Newbigin. Self-incompatibility is a genetically determined ability that prevents inbreeding in many flowering plants. Because the interaction of pollen (the male gametophyte) and pistil (female sexual tissues) is a simple system amenable to many types of experiments, self-incompatibility has long been used as a model of cell-cell communication. The genetic control of self-incompatibility is also experimentally tractable, as all the major genes are at a single, allele-rich, *S* locus. This has led researchers to seek these genes as a way to understand both the processes that lead to pollen rejection and how the system has evolved. Among the important discoveries made recently by the group are the cloning of pollen-expressed genes from the Solanaceous *S* locus, the detailed characterisation at the molecular and genetic levels of plants with mutations that specifically affect the self-incompatibility phenotype of pollen, and the 3D structure of the extracellular ribonuclease that mediates the rejection of incompatible pollen. This structural study was done in collaboration with Professors Fumio Sakiyama, Shigemi Norioka and Mamoru Sato from Japan and used the Spring-8 synchrotron, the world's largest third-generation synchrotron radiation facility. Recent papers with Marcy Uyenoyama of Duke University have helped establish a better theoretical understanding of how *S* alleles evolve, and a paper published last year with Pam Green from Michigan State University hints that ribonucleases may help regulate membrane permeability or stability in yeast, a finding that could provide clues as to how these enzymes function in the self-incompatibility response.

One of the programs headed by Tony Bacic aims to define the mechanism(s) by which a family of cell surface molecules, the arabinogalactan-proteins or AGPs, regulate diverse biological processes fundamental to plant growth and development. This research is conducted in collaboration with Dr Carolyn Schultz, now at the Department of Plant Sciences, University of Adelaide. Keen Phytogen readers may recall Carolyn mentioning AGPs in an article last year (Today's Life Science Vol.**13** (5) – *Eds*). AGPs are high-molecular-weight proteoglycans that usually contain 1-10% protein. Their protein backbones are typically rich in hydroxyproline/proline (Hyp/Pro), alanine (Ala), serine (Ser) and threonine (Thr). The Hyp residues are usually substituted by carbohydrate chains (5-25 kDa) which are type II arabino-3,6-galactans, although short arabinosides have also been found. AGPs are secreted from plant cells where they are either anchored to the plasma membrane or soluble in the extracellular matrix/cell wall. Two major recent findings have been the discovery of large families of AGP genes in *Arabidopsis* and the sequencing of the glycosylphosphatidylinositol (GPI) membrane anchor. These data offer a new framework for considering AGP mode of action, primarily through exploiting the genetic approaches now available through the *Arabidopsis* genome-sequencing project.

Focusing on one state's research per edition

This edition:

THE FAR WEST: WESTERN AUSTRALIA

Plant Molecular Biology Group
Biochemistry & Molecular Biology
School of Biomedical & Chemical Sciences
The University of Western Australia

By Joshua Heazlewood and David Day

Functional Genomics of Plant Mitochondria and Symbiotic Nitrogen Fixation

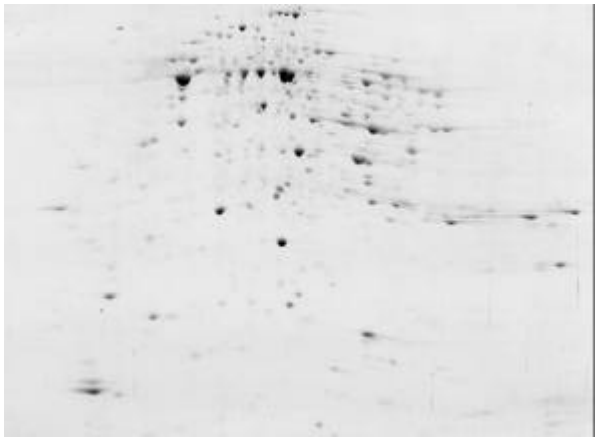
The Plant Molecular Biology Group within the School of Biomedical & Chemical Sciences at UWA, is comprised of three research labs (led by David Day, Jim Whelan and Harvey Millar) that bring together a variety of techniques for the elucidation of mitochondrial function in plants and the identification of nutrient transport pathways in legume nodules. These techniques range from basic biochemistry and membrane biology, through molecular cell biology and genetics to proteomics and bioinformatics. The group consists of approximately 25 researchers, which usually includes an international visitor or two.

FUNCTIONAL GENOMICS OF PLANT MITOCHONDRIA

About three quarters of the research group have as their objective a global analysis of plant mitochondrial structure, biogenesis and function: that is, what mitochondria are comprised of and how and when they are made during plant development. The effects of oxidative stress on these processes, especially on mitochondrial-nuclear interactions, are also studied.

PLANT MITOCHONDRIAL PROTEOME ANALYSIS

Although mitochondria play a vital role in plant growth and development, our current understanding encompasses only a subset of biochemical pathways and their regulation. Since mitochondria import approximately 95% of their proteins from nuclear derived precursors, an analysis of the mitochondrial proteome is an essential part of the group's focus. We estimate that functioning mitochondria contain approximately 1200 proteins, with our current knowledge in plants limited to about 10% of this figure. A complete map of the mitochondrial protein population or proteome is thus essential for the discovery of novel pathways. We are currently constructing and analysing mitochondrial proteomes from *Arabidopsis*[1] and rice (pictured), utilising 2D-PAGE and mass spectrometry. The establishment of these proteomes enables us to further examine mitochondrial development and function.



MITOCHONDRIAL BIOGENESIS

Mitochondria have a small genome of their own. However, most of their proteins are encoded by nuclear genes that are imported from cytoplasmically synthesised precursor pools. This interaction between mitochondrion and nucleus is an important aspect of mitochondrial biogenesis. Part of our research effort focuses on investigating expression of mitochondrial proteins in various developmental processes, such as seed germination, cotyledon and leaf development, and climacteric fruit ripening[2]. The pathways for protein import into mitochondria are also studied. Several distinct protein import pathways have been identified and it is now apparent that the import process itself may be an important post-transcriptional and post-translational control point in mitochondrial biogenesis. The complex genetic history of mitochondrial proteins is also investigated and it appears that during evolution, the mitochondrion has borrowed proteins from nuclear ancestors and plastids (they even share proteins with plastids), to achieve all of its functions[3]. The signals and signal transduction pathways responsible for the regulation of mitochondrial protein expression is also being studied. The ultimate goal is to understand how mitochondria and the nucleus communicate, and to identify the molecules that mediate this communication.

MITOCHONDRIA & OXIDATIVE STRESS

The establishment of the *Arabidopsis* and rice mitochondrial proteomes enables us to undertake a global analysis of mitochondrial form and function under various conditions. Oxidative stress in plants is often caused by changes in environmental conditions and often leads to the production of reactive oxygen species (ROS). Mitochondria respond to these increases in ROS through the enhanced expression of various control mechanisms e.g. heat induced proteins (HSP family), alternative oxidase (AOX) and uncoupler protein (UCP). We are currently using *Arabidopsis* and soybean tissue culture, and rice seedlings, to observe the effects of various oxidative stresses on the regulation of gene expression and the mitochondrial

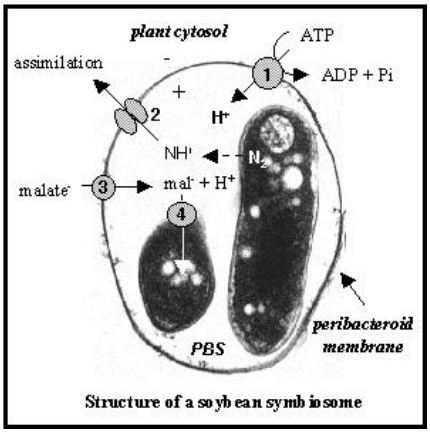
proteomes. Changes that occur in the proteomes are subsequently identified through mass spectrometry. This approach allows us to document global changes occurring in mitochondria under oxidative stress. This approach is complemented by other studies that focus on specific mitochondrial enzymes, such as glycine decarboxylase and AOX, during environmental stresses such as high light, temperature and drought. Changes in mitochondrial function during senescence of organs are also being investigated.

MITOCHONDRIA & PLANT DEFENCE

Mitochondria have been proposed to be involved in plant responses to pathogen attack, especially viruses, both in the hypersensitive response via cell death pathways and in systemic responses. We are using transgenic plants with altered mitochondrial function to elucidate the mechanisms involved, focusing on the role of ROS and control of mitochondrial protein expression by signalling molecules such as salicylic acid and nitric oxide.

NUTRIENT TRANSPORT ACROSS SYMBIOTIC MEMBRANES OF SOYBEAN NODULES

Within the research group, a team of five focuses on a project involving the characterisation of transport processes within N_2-fixing legume (mainly soybean) nodules. Some plants, many of them legumes like soybean, form symbioses with soil bacteria (rhizobia), which are able to biologically convert atmospheric N_2 to ammonia for use in the plant, a process termed symbiotic N_2 fixation. These plants are able to grow in the absence of added nitrogen fertiliser with obvious advantages for sustainable agriculture.



Structure of a soybean symbiosome

Biological N_2 fixation involves the conversion of atmospheric N_2 to NH_3, a reaction catalysed by the enzyme nitrogenase, which is found only in certain prokaryotes, including members of the Rhizobiaceae, which form symbioses with legumes. Symbiotic N_2 fixation takes place in specialised organs on the roots of the host plant, called nodules. The infected cells of these organs house the nitrogenase-containing forms of the rhizobia, called bacteroids. Within the specialised environment of nodule cells, the bacteroids fix atmospheric nitrogen into ammonia, which is supplied, to the host: in return, the host supplies reduced carbon to the bacteroid. Bacteroids inside the infected root cells are surrounded by a peribacteroid membrane (PBM) of plant origin, which effectively segregates the bacteroids from the plant cytoplasm and determines the type and quantity of compounds that pass between the symbionts. The principal metabolic exchange that occurs between the symbiotic partners is reduced carbon to the bacteroid for fixed nitrogen to the plant, but other important nutrient exchange also occurs. We are interested in the interactions that occur across the PBM and use soybean nodules as a model system. In particular, we are identifying and analysing ion channels and other transport proteins on the peribacteroid membrane using a variety of different techniques. To date we have identified a malate transporter, a proton-pumping ATPase, an ammonium channel and iron and zinc transport systems[4]. We are now attempting to clone the genes that encode these proteins.

1. Millar AH, et al. (2001) Analysis of the *Arabidopsis* mitochondrial proteome. Plant Physiol. 127. 1711-1727.
2. Considine MJ, et al. (2001). The expression of alternative oxidase and uncoupling protein during fruit ripening in mango. Plant Physiol. 126: 1619-1629.
3. Adams, KL, et al. (2002) Genes for two mitochondrial ribosomal proteins in flowering plants are derived from their chloroplast or cytosolic counterparts. Plant Cell (in press).
4. Day DA, et al. (2001). Nutrient transport across symbiotic membranes from legume nodules. Aust. J. Plant Physiol. 28: 667-674.

Plant & Crop Physiology Research

Department of Agriculture
Western Australia

By Dr Tim Setter (Senior Cereal Scientist)

The goal of physiological research at Department of Agriculture, WA (WADA) is to use physiological (mechanistic) approaches in collaboration with crop breeders and agronomists to enhance cereal production through use of new technologies. The major focus of physiology research at WADA is on the tolerance of cereals (wheat, barley and oats) to abiotic stresses. A key impact of this research is to bring plant and crop physiology to the field.

Physiology research at WADA is conducted in teams using the strategy highlighted by Tim Fowers and Tony Yeo (UK): "*Any (breeding) program for raising the resistance (to salinity) of conventional crops is going to be far from simple and likely to involve a team of scientists rather than a single plant breeder*" (Flowers and Yeo, 1995).

Physiology research at WADA is both applied and strategic. This is a consequence of research focused on germplasm improvement to support cereal industries; and it highlights the requirement of WADA to collaborate with universities and other institutions to supply a major portion of basic research. Common outputs on various abiotic stresses include: development of germplasm screening protocols, phenotyping to characterise State, National and International germplasm for breeding programs, development of new projects focused on germplasm improvement, student co-supervision, and evaluation and contribution to biotechnology approaches. Current priorities of abiotic stresses are waterlogging, salinity, drought and heat, aluminium tolerance, boron tolerance, and grain quality factors including sprouting and blackpoint.

At WADA, the first general project on "Molecular Markers for Abiotic Stresses in Wheat (DAW724) commenced in 2001. This new project captures the priorities of WADA physiological research on multiple abiotic stresses; it evaluates available molecular markers for suitability in WA germplasm; and it develops new molecular markers for aluminium tolerance and waterlogging based on phenotyping led by physiologists. This project forms the basis for enhanced linkages with the Cooperative Research Centres for Molecular Plant Breeding (CRCMPB) and Value Added Wheat (CRCVAW).

Four examples are used below to highlight some of the physiological research on cereals at WADA. This research highlights a growing application of plant and crop physiology in two areas of:

(1) meeting industry objectives in what is sometimes refered to as "production physiology," and
(2) developing molecular markers, that is, where physiologists are actively involved in phenotyping germplasm. The latter occurs by several approaches including evaluations in target environments, development of rapid laboratory screening protocols and detailed physiological analyses.

Sprouting Tolerance

Loss of production due to pre-harvest sprouting in wheat is estimated at $25 to 37.5/ha in affected areas. Usually about 100,000 ha/annum is affected by sprouting in WA; however, over 1999-2001 the area affected

was several times larger. Sprouting has now become a top priority for wheat and barley improvement and research at WADA.

In November 2000, we formed a team of breeders, crop variety testing officers, grain chemists and physiologists to evaluate sprouting tolerance in breeding lines and in released varieties of wheat grown in WA. This developed to increase the accuracy of germplasm ratings for sprouting tolerance, relative to evaluations based on plants grown in the Eastern States, since minimum standards of sprouting tolerance were recently introduced at WADA. Subsequently we showed, in collaboration with paired analyses of samples by Dr Daryl Mares (then at Narrabri, NSW and now at Adelaide University, Department of Plant Science), that the original ratings of sprouting tolerance could be different for specific lines. This change in sprouting tolerance evaluation enabled a new wheat variety, *Wyalkatchem*, to be released in WA. Current and future research on sprouting aims at: (1) collaborating with breeders and physiologists in WA and Eastern States to develop moderately resistant and resistant germplasm (long term), (2) exploring new mechanisms / genes for sprouting tolerance in international germplasm, (3) responding to grower questions to evaluate whether sprouted grain is suitable for sowing next season, and (4) work with the CRCMPB and CRCVAW to validate markers for sprouting in WA germplasm.

Waterlogging & Flooding Tolerance

Loss of wheat and barley production due to waterlogging in WA and VIC is estimated at $24.50/ha in affected areas. Loss in total crop production due to waterlogging in an average rainfall year has been estimated to cost growers $25 million in WA alone. Substantial physiological research at WADA is directed to germplasm improvement for waterlogging tolerance, since shallow duplex soils, which account for over half the soils in WA, rapidly waterlog due to low permeability of the compacted B-horizon.

Research on waterlogging has involved multidisciplinary teams of breeders, soil scientists, physiologists, agronomists and molecular biologists through the development of International and National projects (ACIAR), State projects (DAW292, DAW724 and UWA340 funded by GRDC) and the co-supervision of students (ARC). ACIAR project research includes collaboration with WADA breeders (Dr Iain Barclay, Robin Wilson and Hossein Saberi) and VIDA breeders in Victoria (Dr Russell Eastwood). Currently, Dr Tim Colmer's physiology group at UWA is exploring adaptive physiological traits including radial oxygen loss and root alcoholic fermentation as part of this research. In addition, over 15 research staff contribute from three institutions in Northern India: The Directorate of Wheat Research, the Central Soil Salinity Research Institute and the ND University of Agriculture and Technology.

Physiological mechanisms under evaluation include those contributing to tolerance during waterlogging, or after waterlogging during the recovery phase. There is genetic diversity for tolerance both during and after waterlogging (Tim Setter and Irene Waters, *unpublished data*). Some interesting challenges remain for this research, including determining whether mechanisms of waterlogging tolerance are the same in different tolerant genotypes. Secondly, whether adaptive traits are the same for waterlogging in neutral duplex soils, where waterlogging occurs from the bottom up, relative to alkaline sodic soils, where waterlogging occurs from the top down.

Success to date has included the development of four waterlogging tolerant, doubled haploid (DH) wheat populations. These populations will be used for detailed physiological research and for the development of molecular markers through research with Murdoch University and the CRCMPB led by Dr Rudi Appels.

Utilisation of Stem Carbohydrate Measurements for Drought Tolerance

In WA wheats, a majority of carbon for grain filling comes from stem stored carbohydrates (fructans) accumulated prior to grain filling, which is vastly different from wheats developed for irrigated conditions where most of the carbon is assimilated during the grain filling period. This accumulation of stem carbohydrate gives WA wheats a distinct advantage of yield stability in our drought and heat affected environments, because extensive leaf photosynthesis is not required during maturation, and there are positive effects on sink size (Conocono, PhD thesis, submitted).

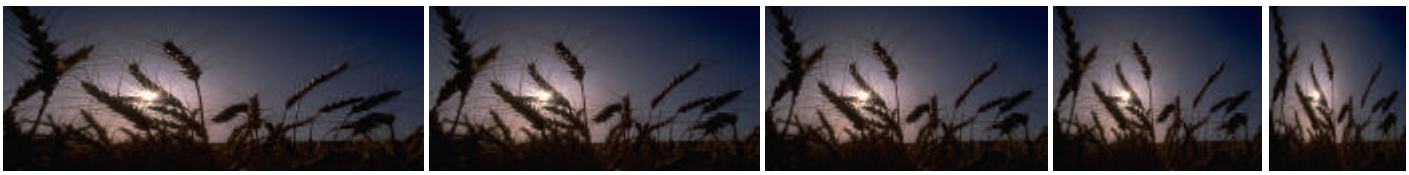
This research aims to develop selection criteria for high yielding wheat in low rainfall areas of the Western Region by: 1) Evaluating the genetic diversity for accumulation of stem carbohydrates, and demonstrating its importance to supplementing carbon for grain filling, and 2) Demonstrating the importance of stress tolerance during grain filling in medium and low rainfall areas of the Western Region.

Analysis of plant samples from field trials over several years has shown that a high degree of genetic diversity exists in stem carbohydrate storage in a set of 40 Western Australia cultivars and crossbreds, with stem carbohydrates potentially accounting for high values of 25 to 35% of the final grain weight for most lines. Those WA cultivars with similar carbon assimilation patterns (leaf chlorosis during grain filling) displayed a good relationship between high stem carbohydrate levels and high yields ($r^2 = 0.43$; Setter *et al*., *unpublished data*). Field studies have also shown that when plants are exposed to supplementary light for about a week prior to flowering, stem carbohydrates and grain yield of some cultivars can be increased by up to 50%. These results suggest that the grain yield potential of these types may be increased if stem carbohydrate is increased using appropriate genetic material.

Current research at WADA by Dean Diepeveen involves (1) evaluating drought tolerance and stem carbohydrate accumulations in the top 25 WA wheats; (2) commencing routine assessments of stem carbohydrates in Stage 4 wheat breeding lines; and (3) completion of DH populations based on crosses with International germplasm with high yield potential and high stem carbohydrate accumulations. This research is currently being extended to the evaluation of germplasm improvement in barley (Blakley Paynter) and lupins (Bob French).

Salinity

Salinity, sodicity and low soil moisture, limit yield of wheat and barley in a high proportion of Australia. Dryland salinity affects about 10% of the 18 m ha of agricultural land in WA, and it is predicted that eventually 30% of the Southwest agricultural area in WA may be affected. On the duplex soils of WA, salinity is often associated with waterlogging in winter. Cereal germplasm improvement for salinity tolerance is therefore a top priority for physiology and breeding research in the future. In 2002, a proposal was submitted to GRDC outlining the establishment of teams of physiologists and breeders in the West (WADA and UWA) and Eastern States (CSIRO, Canberra; VIDA) to commence physiological approaches to germplasm improvement using a wide range of wheat and barley germpalsm.



Functional Plant Biology

Autumn Update

FPB: The First Issue

Welcome to the first seasonal update from *Functional Plant Biology*. In January 2002, the staff of CSIRO PUBLISHING joined Suzanne and me to proudly open a bottle of champagne in celebration of the first issue of FPB. The changeover went smoothly, the website is working well, and we are very happy that all our authors and reviewers have given their support through this time of change.

We are currently surrounded by change. The ASPB in the USA is currently undergoing change for both its Society and journal name. Melbourne's main daily Newspaper, *The Age*, has undergone a significant change in layout and design. It is also heartening to see the response to the recent vote amongst ASPP members to change the Society name to ASPS. As we have learnt through the past year of journal activity, a name change involves a great deal of hard work, promotion and reassurance! Change must come about only when backed by valid reasons and supportive membership. Everyone at FPB congratulates the ASPS on its name change and looks forward to continuing to be a strong partner.

To Authors: Faster Electronic Delivery

We have been working hard to increase the efficiency of manuscript handling at all stages of the chain. We now ask all authors to send original submissions in electronic format as well as hardcopy. This enables us to send the abstract of your manuscript to a potential referee before they accept the job! Once they accept, we send the whole manuscript attached to an email, either as a Word document, or as PDF if requested (which we make up from your Word document). Any figures not available at the submission stage as electronic files must be submitted as three sets of hard copies. This enables us to send one set out to each referee, so they are looking at the highest quality figures available when they assess your manuscripts, rather than photocopies. Once the reports are back in, we write to the authors and send the reviews by email. This has received a very enthusiastic response from authors, who enjoy much faster feedback:

"Thank you for sending the reviewers' comments on our submitted paper. It is the first time I have received reviewers' comments via e-mail. I really find it a major improvement as far as speed is concerned."

We now provide *in press* authors with a PDF of their proof, rather than a faxed copy. This offers many benefits at each end and helps us get your paper corrected and off to the printer rapidly.

To Referees: Feedback on Reviews

Since last year, I have been sending referees a copy of the other referee's report, which many of you have reported is a valuable way of checking that your comments are not overly harsh or lenient. I also send a copy of my letter back to the author, suggesting major or minor revision on their manuscript. The feedback so far has been extremely positive, as you obviously like to know the 'fate' of those manuscripts over which you spent several nights slaving! I also notify referees when a manuscript has been accepted for publication, with an indication of the month of publication, or when a manuscript has been rejected (without divulging the full details, which some authors would prefer to keep private). Where there is a spare reprint, I often send that to a referee also. These are some of the ways that I try to keep a happy and well-informed 'pool' of referees.

The FPB Editorial Advisory Committee

At the time of writing, we are currently preparing for our annual editorial advisory committee (EAC) meeting, held in February each year. At this meeting, we discuss aspects relating to past performance and future strategies of the journal. The ASPS membership is represented on our committee by Hans Lambers, and the NZSPP by Jocelyn Eason. The rest of the committee is made up of Tina Offler (chair), Jann Conroy, Michael Djordjevic, John Evans and Bob Furbank (see our website or inside the front cover for details). Please contact any committee member or the Editors if you would like to have input into FPB.

Until next time….

Dr Jennifer McCutchan
(Managing Editor – FPB)

TWIGS & BRANCHES

News & Comments from the Plant Science World

Closest Land Plant Relative

Some 470 million years ago, the first land plants emerged from prehistoric waters, put down roots in soil and ended up ruling the plant world. Scientists until now have not been certain about the family history of those pioneer plants. A group of University Maryland researchers have confirmed that the closest living relative of the first land plants is a group of green algae called the Chorales, which survives today in fresh water around the world (Science Dec 14 2001).

Explosive Plant Research

If you are after excitement, check this out! As you are all no doubt aware, TNT is a persistent and toxic military explosive. Well Hannink and colleagues have shown that transgenic tobacco plants can tolerate and detoxify TNT at levels that are commonly found in contaminated sites. Through the integration of a nitroreductase gene from bacteria, the plant is able to reduce TNT to HADNT, which is in turn further reduced to ADNT. Full details of the article can be found in Nature Biotechnology **19**: 1168-1172.

How is the Memory?

Can you remember last winter? Plants can! Gendall and colleagues (Cell **107**: 525-535) have shown that plants have a remarkable capacity to remember. The research group has identified the 'memory' gene VRN2 (vernalization2). While VRN2 is not affected by cold treatment, it remembers that the cold treatment has been provided, thus permitting flowering when the plant is returned to warm conditions.

More Pesticide Harm

DDT, 2,4-D and 2,4,5-T have been linked to cancer and many other nasty diseases or birth defects in humans and animals but now a report that it affects one of the most important symbiotic interactions in agriculture. These pesticides can interfere with the signalling pathways that lead to nodule formation in legumes by rhizobial bacteria (and hence preventing nitrogen fixation) (Nature 2001 413, 128-129).

Donald Danforth Center Opens

The Donald Danforth Plant Science Center is a non-profit, independent center that is a partnership between Missouri Botanical Garden, Monsanto, Purdue University, University of Illinois, University of Missouri-Columbia, and Washington University with additional support from the Danforth Foundation and the State of Missouri. Projects focus on a range of interests from plant-pathogen interactions, enzyme crystallography, plant vaccine development, tissue culture and mineral acquisition by roots. Visit www.danforthcenter.org for more information.

Jason & Amanda Able

Structure and functioning of cluster roots and plant responses to phosphate deficiency – a recent workshop.

Over 60 plant Scientists assembled at the University of Western Australia (UWA) in November 2001 to participate in a workshop on 'Structure and functioning of cluster roots and plant responses to phosphate deficiency'. Among other sponsors, our Society contributed to this important workshop along with the GRDC.

Approximately half of the participants were from outside Western Australia, including 23 from abroad (France, England, Germany, Japan, New Zealand, China, Scotland, South Africa, Switzerland, The Netherlands, USA and Wales). For the first time, plant Scientists researching very different aspects of the structure and functioning of proteoid or cluster roots were brought together to discuss their work. Research from molecular biology and biochemistry, through to physiology and agronomy, anatomy and morphology, ecology and even geology was covered. Lively discussions followed each paper and several arrangements for collaborative research were made. Abstracts of all presentations are available on the following website: (http://www.agric.uwa.edu.au/plants/seminars/wshopcluster.html), where you can also find additional photographs (to those displayed here) of cluster roots, freely downloadable for your lectures. A special issue of Plant and Soil is being edited, which is scheduled for late 2002. This special issue will also become available as a book.

Proteoid roots derive their name from the Proteaceae family, where they were described almost a century ago. They have since been found in several other plant families, including Casuarinaceae, Fabaceae and Myricaceae, and hence the name cluster roots is often preferred. Several workshop participants reported on their *Lupinus albus* research, which releases large amounts of citrate and malate from its clusters in an 'exudative burst'. These carboxylates mobilise phosphate and micronutrients in soil. The physiology, biochemistry and molecular biology of the clusters of *L. albus* have been studied in greater detail than any other species. Interestingly however, Lindsey Herdman and co-authors (University of Dundee, Scotland) presented results suggesting that the clusters of *Myrica gale* (Myricaceae) show an exudative burst similar to that reported for *L. albus*. Since clusters of *Hakea undulata* and *H. prostrata* also exhibit a distinct exudative burst, it would appear that it is typical for all cluster roots.

Thomas Rost et al. (UC–Davis, USA) dealt with structural aspects paper on aerial adventitious root clusters in *Ficus pumila* vines and the formation of adhesive pads. They have also explored possible similarities between these structures and proteoid roots.

Species with proteoid or cluster roots are often non-mycorrhizal. If, as is widely accepted, their ancestors were all mycorrhizal, why has this alternative evolved? In addition, why are cluster roots so prominent in the Australian flora, which is associated with severely nutrient-impoverished soils? Paul Reddell (CSIRO, Atherton) addressed this core question by comparing a 'primitive' member of the Proteaceae with more advanced species of the same family. The 'primitive' member lacks proteoid roots but has not lost its vesicular-arbuscular mycorrhizal status. The more advanced species with proteoid roots appear to be better at coping with very phosphate-poor conditions than the mycorrhizal member of the same family.

A number of papers reported on the possibility that mycorrhizal species and non-mycorrhizal species with cluster roots access different forms of nitrogen. Heidi Hawkins (University of Cape Town, South Africa) and co-authors tackled this difficult problem using stable isotopes and concluded that mycorrhizal plants in the Fynbos (South Africa) have better access to organic N than Proteaceae. However, Pauline Grierson (UWA) did not reach the same conclusion with the study conducted in the Western Australian Jarrah forest.

Amongst crop species that have cluster roots, *Lupinus* species figure prominently. Mike Bolland and his colleagues at AGWEST have shown that lupins with clusters are efficient at accessing phosphate in Australian 'P-fixing' soils. However, very few *Lupinus* species have the capacity to produce clusters. What is it about the successful species, which do produce clusters, that makes them genetically different? Can we also produce a *L. angustifolius* to form clusters in a similar manner as *L. albus* and *L. cosentinii* do? Enrico Martinoia (University of Neuchatel, Switzerland) and Carroll Vance (USDA, Minnesota, USA) (with their co-workers) are tackling this key problem, which may generate important results for Australia and other farmers dealing with P-fixing soils.

Agronomic issues of a different kind were explored by Mike Bolland and Ross Brennan (AGWEST), who showed that *L. luteus*, which has a root structure they call 'third-order lateral roots'; they are remarkably close to cluster roots. Quite possibly, the relatively large accumulation of cadmium by this species, in comparison with that in *L. angustifolius*, is associated with these roots. Fusuo Zhang and co-workers from Beijing (China), who research on the facilitation of phosphate in wheat, intercropped with suitable species that are superior in accessing phosphate. Intercropping has led to substantial yield increases in China. It may not be a cropping system that is appropriate for Australia but it is quite possible that lessons can be learned from their approach. This is being explored by Maarten Hens and Peter Hocking (CSIRO); who discussed the effects of a crop that is efficient at accessing phosphate on the phosphate acquisition of the next crop.

Erik Veneklaas and co-workers (UWA) compared the agronomic performance of a range of new legumes in glasshouse trials. They demonstrated that carboxylate release and phosphate acquisition are closely correlated. The cluster-root bearing species *L. albus* was superior in accessing phosphate in a range of Western Australian soils, but several others exhibiting high exudation rates without cluster roots performed more efficiently than wheat, which has very low exudation rates. Manny Delhaize (CSIRO, Canberra) addressed the question of whether manipulation of citrate metabolism in *Nicotiana tabacum* roots can enhance citrate efflux and hence improve a plant's ability to access phosphate in soil. It would appear that changing activities of citrate synthase or isocitrate dehydrogenase cannot readily change internal citrate concentrations. This may indicate a key role for a citrate channel in the plasma membrane as the major control point of exudation rates, which was further explored by Peter Ryan (CSIRO, Canberra).

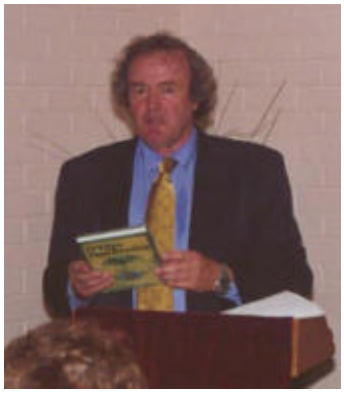
At the other end of the research spectrum, a number of papers were presented dealing with the effects of exudation on long-term soil processes. Philippe Hinsinger (INRA, Montpellier, France) dealt with the major impact of root acidification on chemical transformations in soil, other than those having short-term effects on nutrient acquisition. John Pate (UWA) and Bill Verboom (AGWEST) and their co-workers further developed their theory that laterite formation is very much due to the activity of clusters roots. They propose that ferric layers in laterites and related oligotrophic soils are manifestations of plant and bacterial activity directed at the acquisition phosphate and micronutrient. The generation of leachable iron-rich organic complexes are suggested to be instrumental in ferric rind production.

Hans Lambers

International Association for Plant Tissue Culture & Biotechnology's (Australian Branch) Meeting

University of New England
Armidale, Australia
January 2002

This meeting was well attended with over 40 delegates participating.



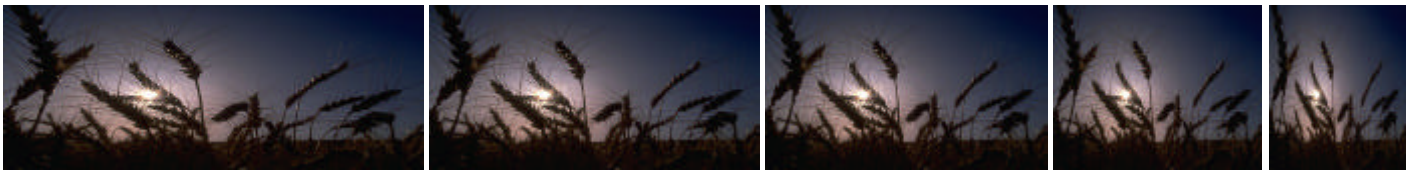
Professor Peter Flood opened the Conference and launched the book "*In vitro* Plant Breeding" authored by Taji, Kumar and Lakshmanan, and published by Haworth Press, USA.

Informative, interactive poster sessions were held throughout the duration of the conference, while the best student oral presentation was awarded to Zulkarnain.

Invited speakers to the meeting included Professor Richard Williams (Gatton College, University of Queensland) and Dr Sudhersan (Kuwait).

Dr Martin Barlass delivered the Michael Mullins Memorial Lecture.

The conference dinner was held in the historical Booloominbah building.



THE PLANT NUTRITION AWARDS

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

THE TRUST invites applications for awards to assist in carrying out a study tour or to attend a conference or other such activity related to the stated objectives. In making an award an applicant's scholastic achievement and recent contribution to industry, research or technology transfer, and their potential for future contribution will be considered. The amount of each award will depend on circumstances but is likely to be under $2,000.

In 2001 there were seven awards made. In 2002 there are to be two categories of awards:

- **THE ALF ANDERSON AWARDS**. Applicants must be actively involved in any of the research areas of plant nutrition mentioned above.
- **THE SAM TISDALE AWARDS**. Applications should have a strong emphasis on sulfur nutrition of plants.

Applicants must be Australian citizens or permanent residents and be based in Australia, except that for the Sam Tisdale Award, Australian citizens may sponsor candidates from Asia and the South-West Pacific Region.

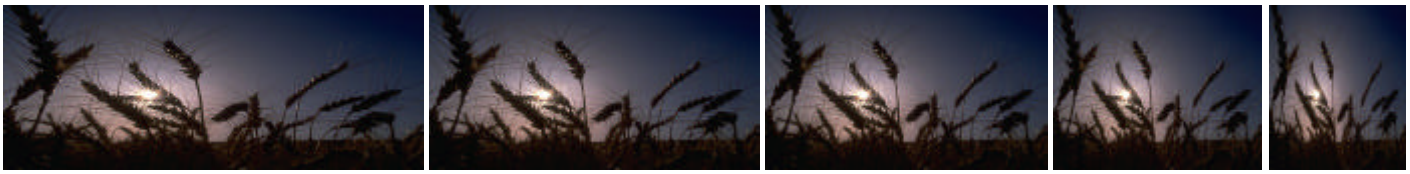
Applications for the current round close on **15 April 2002**.

Application forms can be obtained from:

Dr Peter Randall
CSIRO Plant Industry

GPO Box 1600
Canberra ACT 2601
Fax: (02) 6246 5000
Email: P.Randall@csiro.au

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



UPCOMING CONFERENCES

UPCOMING CONFERENCES

Gordon Conference

Salt & Water Stress

July 14 - July 19, 2002

Cellular Basis of Adaptation to Salt & Water Stress in Plants

Queen's College
Oxford, United Kingdom

For information contact

Mike Hasegawa:
paul.m.hasegawa.1@purdue.edu

Visit the websites:

http://www.grc.uri.edu/programs/2002/salt.htm
http://www.grc.uri.edu/

ICPM 2002

THE 6TH INTERNATIONAL CONGRESS ON PLANT MITOCHONDRIA

JULY 10 – 14, 2002
THE ESPLANADE HOTEL, FREMANTLE, WA

Further Details:

ICPM2002,
Department of Biochemistry,
The University of Western Australia,
35 Stirling Highway,
Crawley Western Australia 6009

Facsimile: + 61 8 9380 1148
Email: ICPM@uwa.edu.au

www.icpm.uwa.edu.au

IRC 2002
INTERNATIONAL RICE CONGRESS

FIRST ANNOUNCEMENT

The inaugural International Rice Congress will take place in 2002 to address issues related to rice research, production, processing, trade and consumption, as well as the sustainable improvement of the livelihood of rice farmers and consumers.

Where: Beijing, China.
When: 16th – 20th September 2002.

http://www.irri.org/IRC2002/introduction.htm

13th Australian Weeds Conference

WEEDS: threats now, and forever?

Sheraton Perth Hotel
Western Australia
9th - 13th September 2002

On behalf of the Plant Protection Society of Western Australia and the Council of Australian Weed Science Societies (CAWSS) we invite you to attend the 13th Australian Weeds Conference. This will be Australia's first weed conference in the 21st Century.

http://home.vicnet.net.au/~weedss/

UPCOMING CONFERENCES cont..

12TH AUSTRALASIAN PLANT BREEDING CONFERENCE

15th – 20th September 2002
Perth
Australia
Conference Theme:
Plant Breeding for the 11th Millennium

The 12th APBC will also herald the beginning of the Australasian Plant Breeding Society Inc., established to meet the professional needs of plant breeders in agriculture, forestry and horticulture in Australia and New Zealand.

For further information:
http://www.congresswest.com.au/PB/

1st INTERNATIONAL CONGRESS ON METABOLOMICS

7th to 11th April 2002
Wageninin, Netherlands
Contact: Emmy van Balen
– E.vanBalen@plant.wag-ur.nl

Plant Biology 2002

3rd – 7th August 2002
Denver, Colorado, USA

Selected Featured Symposia:
President's Symposium - "Dynamic Processes"
Gibb's Medal Symposium - "High Throughput Plant Biology in the Post-Genomics Era"

Abstract Call (Posters/Mini-Symposia): November 2001
Abstract Submission Deadline: 1st March 2002

Further information:
http://www.aspb.org/meetings/pb-2002/prelim.cfm

LIGHT READING!

Did you get some light reading for Xmas or a birthday – then do not hesitate to send us your reviews of good textbooks, plant science books or science in general.

Are you interested in ethics, multinationalism and their effects on science? Well if you aren't as a scientist, then perhaps you should be as a consumer. The book 'Lords of the Harvest: Biotech, Big Money and the Future of Food by Daniel Charles (2001), Perseus Publishing, Massachusetts delves into exactly this. Charles focuses on the introduction of Roundup-ready maize to the market and all the emotions and motives of the players involved in this 'GE-fight'. Introducing some of the players: One team seems to have one sole player - Monsanto – the GE multinational protagonist. Other players usually on a different team include: Pioneer, King of Seeds, Greenpeace and other environmentalists, Jeremy Rifkin and the regulators. The insight provided by this book into the world of multinational biotechnology and GE food makes it well worth a read.

WEBSITES

A wheat metabolomics service site is soon to be up and running on the web, where you will be able to compare non-GM with GM wheat in conjunction with the UK food standards agency. The address for this website is: http://www.foodstandards.gov.uk/.

Check this site out! http://www.scidev.net/

Sponsored by Nature and Science, this site is free and dedicated to discussing and reporting on those aspects of modern science that are relevant to sustainable development and the social and economic needs of developing countries.