Congratulations flowed in earlier this month after the ARC confirmed that the Centre’s extension application was successful, providing us with AU$ 6.9 million of funding through to 2010. This funding, together with nearly AU$ 3 million from partner universities and the NSW State government, will be applied to maintain the scientific momentum of the Centre and allow the Centre to re-focus its research themes to develop end-user directed programs such as those dealing with agricultural sustainability, biofuel production and pharmaceutical benefits. New research themes for phase two are: i) roots in restrictive soils; ii) modified shoot number and resource allocation; iii) expanded symbiosis; iv) floral embryo and seed development control; and v) bioactive molecules bridging plant and animal systems. These themes have the potential to provide huge national benefit to Australia and will significantly impact and expand our current knowledge of plant systems.

As a result, the CILR will be developing a new strategic plan for 2007-2010 and Meristomics will play a larger role in aiding the Centre to secure more funding from industry sources through the commercialisation of CILR technology. In 2006 the Centre was successful in gaining funding from Queensland based biofuels company Pacific Renewable Energy Pty Ltd, Education Queensland and UQ’s technology transfer company, UniQuest Pty Ltd. Combined with other successful competitive grant applications and newly patented technology, the CILR is firmly establishing itself as a biotechnology industry player.

Thank you to all staff and students who traveled to the UQ node for the day-long review and special thanks to all the UQ node students who were unexpectedly called upon to sit before the panel with approximately 5 minutes warning.

With phase two funding, the CILR can now delve even deeper into the questions of plant growth, stem cell differentiation and control, and nodulation. In addition, the Centre can now branch out into new industries emerging in the field of plant science.
New for 2007: the CILR Wall Calendar!

Featuring photos taken by CILR researchers, the CILR wall calendar provides a functional yet colourful addition to any office! If you have not received your copy yet, or would like more, please contact Lisette Pregelj at lisette.pregelj@uq.edu.au or (07) 3346 9534.
How wonderful it is to have reached this point. We finally received the information from the ARC that the CILR will be extended for a further three years beyond 2007. This gives us nearly four years to prepare for the future.

The ARC allocation of AU$ 6.9 million (in 2006 dollars) will be matched by nearly $3.0 million from partner universities and the NSW State government. At the same time, our Centre has direct support through Australian scholarships to many of our graduate students (APA, GRDC, and others), as well as AUSAID and overseas government scholarships. Visiting postdoctoral researchers are supported by their own national governments, and all CIs, other than me, are supported by salaries directly made available by the partner universities. This ‘collateral’ support accounts for approximately $2 million per year making the CILR scientific cash investment about $16 million over the three-year period from 2008-2010.

Such investment into modern plant science is very encouraging, but with it comes responsibility. How do we structure our research to best advance knowledge? How do we address current problems such as restrictions in water and fertiliser availability to plants? How do we tackle the protein and fuel security issues confronting both the developed and developing world? How do we best train the young scientists who will ‘fill’ the shoes of some of our more established Centre scientists? How do we empower the developing young scientists within our Centre to become the future leaders and decision makers? How do we create the opportunities of employment, so that young untenured scientists of great capability find positions within the Australian science scene, thus allowing the ARC investment to mature within the national framework that provided the funds for its initiation?

We should all be inspired by the recent career successes of another Australian, namely Professor Ian Frazer, who climbed onto the world scientific stage with the development and commercialisation of a vaccine against Human Papilloma Virus (HPV; one of the causes of cervical cancer). His success has been built upon 17 years of development, struggle and uncertainty. How does this compare to some of our work? Who will have the patience and financial depth to support research into plant growth and development for 17 years?

By the end of 2010, we will have enjoyed eight years of better than adequate science funding. How will we have used this opportunity to propel our research (and the career of its discoverers) forward to continue? The Centre will have failed, if by 2011, we have no more than publications, graduated students, patents and ‘good memories’. It is NOW that we need to consider the avenues for continuity and the opportunity to build upon our firm scientific base.

I personally believe strongly in the power of discovery science. To describe and understand the mechanism of a process provides eternal knowledge. Thus mechanistic science to me is more powerful than descriptive science. To know “HOW” something works seems more lasting than knowing “THAT” something works. However, in today’s political science environment, our research also needs to be on the path towards benefits to society and the public that supports the research. Whilst we need to be vigilant towards hyperbole and raised expectations, we also need to be able to communicate our vision of the research and its potential outcomes. The Centre’s Outreach and Education program, along with the activities of its staff and students, is essential to achieve this presentation of the research mission and vision. Whilst not all of our studies will lead to a better plant and commercial profits, with the breadth of approach and complexity of talents, we have the chance to produce several ‘winners’.

The next few months will see a mature and directed period of research planning along our disclosed research themes, our stated mission and vision, utilising our Centre Scientific Expert Advisory Committee, our broader contacts to the Australian science scene (through the Centre Advisory Committee and Centre Associates) and reciprocal internal discussions. We will focus on key words in our Centre’s name: **Integrative; Excellence;** and **Legumes**. I hope that you all will join me in shaping the exciting future that has been made possible for us.

Peter M. Gresshoff  
Director, CILR.  
March 2007
Legumes: Creating jobs for Lajamanu women

*Acacia* seeds are traditional desert staples; knowledge about species identification, abundance, edibility, habitat, the ecological effects of fire and rain, and the technical aspects of harvesting and cleaning seed are all part of the rich store of plant knowledge still held and practiced by the Warlpiri people of the Tanami Desert region of Central Australia.

Currently there are programs in place to develop a sustainable small-scale native bush foods harvest industry in Central Australia for the desert people. In alignment with the Desert Knowledge CRC (DKCRC), CILR PhD student Miles Holmes is aiding ladies of the Warlpiri community of Lajamanu to become involved in the ‘wild harvest’ enterprise.

The commercial sale of bush food is a small but growing sector within Australia, as well as internationally. Wattle Seed (*Acacia* sp.) and Bush Tomatoes (*Solanum* sp.) are the main central Australian species being promoted. In October and November 2006, Miles was able to facilitate the Lajamanu ladies access to this industry. The Lajamanu enterprise focused on the collection of *Acacia* seed of the species *Acacia coriacea*, *Acacia colei* and *Acacia cowleana*.

Commercial harvest is not something the Lajamanu people had previously experienced. However after some initial training regarding species currently in demand and collection and storage methods required for commercial sale, they were able to utilise their traditional knowledge and immediately begin collecting seed.

The harvest technique requires considerable practice and subtle skills to perform efficiently. A suitable stand of trees at the right stage of ripeness is first located. Then the seeds are shaken off the trees and piled up on a tarpaulin (hard flat ant beds were used in pre-contact times). They are then threshed with a stick to drive the seeds to the bottom of the pile. The top layer of leaves is then thrown away. Finally, the seed is winnowed by allowing it to flow through the hands. The wind blows the light sticks away and the heavy seed falls to the ground.

Collecting seed is hard work, with summer temperatures in Central Australia often approaching 45 degrees Celsius. The Lajamanu harvesters worked steadily through this heat and in total collected an impressive 1000 kg of seed. This provided them with a good financial return and a range of other benefits. In particular, the women talked about the sense of pride and satisfaction they gained from the utilisation of their traditional knowledge. They were also glad to ‘be involved’ with *Acacia* seed again, as it is not something that has been collected much since the introduction of white flour. The women thought that the enterprise was helping to keep the knowledge ‘alive’. As part of Miles’ project, the community school held two excursions so that the kids could help the ladies collect seed, and to provide more opportunities for the transmission of cultural knowledge. Finally, the women expressed pleasure at being able to visit their traditional country in search of seed.
Many songs were sung and cultural information revitalised in relation to the species. Such cultural information is an important component of Indigenous Ecological Knowledge (IEK) and it was frequently stated that Warlpiri Law (i.e. cultural information) about *Acacia* species is just as important and informative as purely ecological information.

The participatory project will continue in 2007 and will seek to build direct relations between the wholesalers and local people so that the project has long term viability and sustainability. It will also explore the reasons why community development projects that utilise IEK in an appropriate Aboriginal context are more attractive to local people. The information gained will be valuable, particularly in the current policy environment where there are limited successes in developing Aboriginal livelihoods.

**Apical dominance and shoot branching**

*Dr Brett Ferguson & Liz Dun*

Regulation of shoot branching is an important survival mechanism for plants. Recent literature has proposed vastly different hypotheses about how the plant hormone auxin is involved in this regulation. Some of these newly proposed hypotheses are contrary to unpublished data from experiments we have conducted, and do not consider how using intact and excised plant systems might influence results. In this update, we distinguish between branching control regulated by the shoot apex and that regulated by alternative mechanisms independent of the shoot tip. Surprisingly, this has not previously received major emphasis. In so doing, we re-evaluate the classical hypothesis for auxin regulation of shoot branching and show how recent findings incorporate prior hypotheses. We also highlight how different hypotheses are predominantly derived from research using either pea or Arabidopsis. These species lend themselves to studies focused on intact or detached systems, respectively, which we argue might lead to different results.

An all-encompassing hypothesis, named the bud transition hypothesis, is suggested to account for conflicting results obtained in different species. The bud transition hypothesis proposes that there are multiple stages of bud development at which an axillary bud might reside: a stage of dormancy, a stage of transition, or a stage of sustained outgrowth. We suggest that many factors, such as photoperiod, decapitation, bud age and the node at which the bud resides can determine whether an axillary bud is in a stage of dormancy or transition. When in a stage of transition, we suggest the bud is receptive to other signals, such as cytokinin or SMS (shoot multiplication signal) that can trigger or inhibit, respectively, the bud’s progression from the stage of transition to that of sustained growth. Thus, different experimental systems could influence the stage at which an axillary bud resides. We therefore propose that different species do not necessarily have divergent mechanisms for branching control but rather that the architecture of different species has led to studies using plants of different developmental stages, grown under different conditions being assessed using different techniques resulting in vastly different outcomes. Thus, our review offers a thorough and timely analysis of how different species and/or techniques can markedly impact experimental outcomes, and therefore conclusions.

Research Highlights

Common Regulatory Themes in Meristem Development and Whole-Plant Homeostasis

Chief Investigators Dr Christine Beveridge, Dr Ulrike Mathesius, Associate Professor Ray Rose, and Professor Peter Gresshoff have recently published a paper reviewing the current literature and thinking on the topic of plant meristem development and whole-plant homeostasis.

The maintenance of meristems throughout plant ontogeny allows the development of a diversity of structural forms from the same genetic base. Examination of the common and contrasting features of these meristems leads to the outline of common regulatory themes in meristem development. In particular, by including comparisons with embryogenesis research, we see that hormones and factors that are generally attributed roles in stress response, such as redox potential, carotenoids, flavonoids, brassinosteroids, jasmonic acid and ethylene, are emerging as major candidates for long-distance or short-distance signalling molecules in meristem development. In each case, hormone response appears to be influenced greatly by the developmental window or transition stage at which the meristem resides.

**Box 1** Terminology for developmental stages from stem cell to outgrowth.

**Specification** defines the first event that determines which type of meristem or primordium identity a cell will take on. Specification does not necessarily lead to further developmental steps (Box Figure 1).

**Activation** defines the process that stimulates a cell or small group of cells to start dividing into an organised meristem and emerging primordium.

**Growth stimulation** is required to promote the transition of a meristem or primordium to a differentiated organ that emerges by elongation. A meristem is a group of cells in which stem cell identity is maintained. Meristems can be indeterminate (e.g. RAM) or might terminally differentiate during development (e.g. a determinate node or determinate lateral root, such as a protoxil or cluster root).

The plasticity of plant development relies on the maintenance of plant meristems as centres of pluripotent stem cells. Different meristems have separate origins and fates but they have similar features. Meristems are specified at defined locations, foci of cell divisions are activated, and growth and differentiation are triggered. The progression of specification, activation, arrest, and growth stimulation during meristem development is worth defining in some detail as these terms are often ambiguous. Although these stages are apparent for different types of meristems, regulatory control in response to environmental or endogenous cues might be commonly exerted at different points, arresting or stimulating the progression of a particular stage. Mutants that cause shoot apical (SAM) or root apical meristem (RAM) arrest are generally embryo lethal, although inducible transgenic systems are becoming available, enabling these processes to be explored. Investigations of the expression profiles of well-characterised genetic systems for apical meristem development are also informative, as are studies of embryogenesis in culture. From a practical point of view, lateral or axillary meristems, such as lateral roots, nodules, and axillary shoot
Research Highlights

meristems, are ‘disposable’ and allow us to investigate the regulation of meristem development throughout the otherwise unperturbed ontogenetic development of the plant. By considering features that are conserved in different types of meristems as development progresses from stem cell maintenance through to organ growth, we seek to identify common and redundant parts of the networks that underlie the regulation of different types of meristems.


Melbourne Node Retreat

The Melbourne Node enjoyed a working lab at Marysville, Victoria. From Friday the 2nd of February until Saturday the 3rd of February, CI’s Prem Bhalla and Mohan Singh and Research Fellows Isabelle Damiani, Wan-Jun Zhang, Xue-Fen Liu, and Annie Wong discussed and planned their work for the year. However it wasn’t all work, the group went on an excursion to Stevenson’s Falls, a local attraction at Marysville, to celebrate the end of the retreat. As you will see from the photos below, they had a relaxing time drinking sparkling wine and enjoying the surrounding waterfalls and waterholes.

Clockwise from Top: Annie presenting to the group; Wan-Jun presenting to the group; Isabelle, Xue-Fen, Prem, Mohan and Wan-Jun relaxing by Stevensons’s Falls; Annie, Isabelle and Xue-Fen enjoy some sparkling wine.
Pod News

Legumes Take the Lead on Biofuels
CILR signs first official research contract

The CILR and Pacific Renewable Energy have entered into an agreement to investigate a little-known legume’s huge potential for biodiesel production. *Pongamia pinnata* is a common tree legume found in India, Asia, Africa, PNG, and parts of Australia. Also referred to as the Pongam tree, it has been used for centuries as a streetscape plant and source of timber. Its oil containing seeds have been harvested for their medicinal purposes and as a source of fuel for lamps and cooking stoves.

PRE has contracted the CILR to investigate Pongamia’s basic biology, as a prelude to determining the legume’s potential for biodiesel production. This new research has the potential to contribute to the revolution occurring in our perception of biofuels.

Australia’s sustainable biofuels industry requires a non-food legume crop with high oil yield capable of growth on marginal land. The first internal combustion engine’s motor ran on peanut oil and peanuts are legumes, so it isn’t such a far fetched idea to develop biodiesel from the legume Pongamia. Pongamia has even greater potential as a source of fuel, as the tree can thrive on agriculturally marginal land, thus not detaining land from food production.

The project will analyse Pongamia’s growth, nodulation and nitrogen fixation, isolate and fingerprint it’s DNA, and determine the best methods for *in vitro* multiple shoot culture proliferation.

CILR Files Third Complete Patent Application

The CILR has filed its third complete patent application identifying that in soybean there exists two copies of the nod factor receptor gene, GmNFR1. When this gene is mutated in the mutant *nod49* and over-expressed in transgenic roots, increased nodulation and nitrogen fixation result. The increased nodulation appears to stem from the attenuation of the internal Autoregulation Of Nodulation (AON) system.

This discovery could potentially provide the means of increasing soybean nitrogen fixation, increasing seed and oil production, and enhancing establishment in low *Bradyrhizobium* soils.
ANU Node Mass Spectrometry Workshop and Symposium

By Yu-Hsiang Lin

The 2006 Mass Spectrometry workshop was held in the month of November at ANU, Canberra. It was attended by four CILR members from the UQ node; Dr Pick-Kuen Chan, Bandana Biswas, Yu-Hsiang Lin and Meng-Han Lin, along with Tersun Kerim from the ANU node.

The first day of the workshop consisted of seminars from experts covering a range of topics such as “Manual interpretation of peptide MS” and “Proteomics - current tools and limitations” which was presented by CILR Chief Investigator Uli Mathesius. In the afternoon, we had the chance to observe the mass specs in action and the use of the analysis software such as MASCOT and SEQUEST. A mass spectrometry symposium was held on the second day consisting of seminars given by various speakers from companies such as Thermo and Invitrogen. It provided us an insight into the latest developments in mass spectrometry technologies.

Overall, the two day workshop was a truly rewarding experience as it gave us an inside look into the technical aspects of mass spectrometry and also raised our awareness to the possibilities of employing this technique in a wide range of research applications.

Mclip: Motif detection based on cliques of gapped local profile-to-profile alignments

A multitude of motif-finding tools have been published which can generally be assigned to one of three classes: expectation-maximization, Gibbs-sampling, or enumeration. Irrespective of this grouping, most motif detection tools only take into account similarities across ungapped sequence regions, possibly causing short motifs located peripherally and in varying distance to a ‘core’ motif, to be missed. CILR researcher Tancred Frickey and Chief Investigator Georg Weiller have presented a tool basing motif detection on cliques of gapped local profile alignments. ‘Cliques’ refer to sets of alignment traces for which all profiles share co-aligned residues.

The input data is a set of unaligned FASTA format sequences and the program uses a multi-step approach to finding motifs. The output is the motifs and sequence regions with high-scoring alignments to the motif. This is similar to MEME and consists of a list of detected motifs, the sequences with significant similarities to the motif, their start, motif-match, end, alignment score, Z-score, and E-value. Mmatch, the motif-sequence alignment routine, is available separately and used to search for motifs found by Mclip in a different set of sequences. Both programs are written in Java, run under MacOS, Windows, or Unix/Linux, and available from:


UQ Node Celebrates 2006

The UQ Node celebrated the end of 2006 with a trip to the beach! Swimming, walking along the water, BBQ-ing and beach cricket were perfect ways to relax, chat, and experience the Australian lifestyle.

Clockwise: Meng, Ali, Peter & Liqi learning about the ‘dicky’ boat at Dicky Beach, Caloundra; walking along the beach; Lisette attempting to score runs; Fulbright Fellow Jeanette learning the skills of Aussie BBQ-ing; new COO Alvin enjoying the day; Satomi, Bandana, Peter and Aura.

Announcements

CILR extension application granted! CILR to stay open until 2010 (see story page 1)

STEP IN LABS to re-run in 2007/2008 after funding application to Education Queensland was granted in December 2006

CILR Annual Symposium will be held from the 11–14 April at Peppers Resort, Kingscliff, NSW. Deadline for abstract submission is Friday 23rd March

Coming up in 2007 . . .

March
26-28 Australian Soybean Conference: 14th Annual Australian Soybean Industry Conference, Bundaberg, Queensland
29–30 UniQuest Commercialisation Workshop—Academic staff, Novotel Twin Waters, Qld

April
11–14 CILR Annual Symposium, Peppers Resort, Kingscliff, NSW, Australia
26–27 UniQuest Commercialisation Workshop—PhD students, Novotel Twin Waters, Qld

Later...
May 6–9: BIO2007, Boston, MA
July 3–5: Functional Genomics Workshop, Australian National University
July 17–21: 13th International Congress on Molecular Plant Microbe Interactions, Sorrento, Italy
Jeanette Simmonds is one of CILR’s new additions. In Australia for 10 months on an Australian American Fulbright Fellowship, Jeanette is researching the history of nitrogen fixation from a community perspective. Her research will look at Australian contributions to biological nitrogen fixation and nodulation studies from the 1950s to the present. Jeanette's PhD thesis, "Community Matters: A History of Biological Nitrogen Fixation in the Molecular Genetics Era", documents the events and science of nitrogen fixation during the field’s first funding boom, which ended in the early-1990s.

In the mid 1970s, the OPEC oil crisis caused the cost of nitrogen fertilizer to increase, which is one of the reasons research into nitrogen fixation became extremely popular. Promises of nodulating non-legumes led to large funding surges into the field, with trickle-over effects into the lesser funded areas of plant-microbe interactions, *Rhizobium* ecology, and inoculant production in developing countries. By the late 1980s and early 1990s it was evident that there was no quick fix on the immediate horizon and when funding became scarcer many scientists left the field.

Jeanette's research involved lengthy interviews with plant scientists, digging up old newsletters and conference proceedings, and reading historical records of old experiments. Through attending conferences, Jeanette met CILR's Peter Gresshoff, Barry Rolfe, Michael Djordjevic, and Uli Mathesius. She conducted formal interviews with both Peter and Barry, as well as some other ex-Australian based legume and *Rhizobium* scientists. Jeanette interviewed a total of 95 scientists in 115 formal interviews.

Australia often came up during these extensive interviews and Jeanette quickly learned that Australian research was pivotal to the history of nitrogen fixation. This led to her application for a Fulbright Fellowship and the CILR! "Peter’s, Barry’s, and Bernie’s work in the mid 1980s was instrumental to the scientific field and I’m honored to be able to witness where that research has led to today."
Pod People

New COO!

Alvin Van Niekerk hails to the CILR from South Africa; another nationality to add to our multi-cultural research group! Alvin started as Chief Operating Officer of the CILR at the beginning of November 2006, a position that also includes the role of Chief Executive Officer of Meristomics.

Prior to his appointment at the CILR, Alvin founded and directed AvN Consulting, specialising in agricultural education, international liaison, policy formation, academic quality assurance, transformation in education, curriculum development, and academic masterplan development.

Alvin has extensive skills and experience in management, administration, communications, and research. He has managed large numbers of people as well as substantial research programs and animal science research components on large research stations. In addition, Alvin has managed and developed administration procedures for large academic institutions, including training programs for staff and new methodologies for presentation of academic programs.

We are very happy to welcome Alvin to the CILR and are looking forward to working with him.

New Researchers!

A number of new researchers have joined the CILR team recently. Dr Xue-Fen Liu is one of the new post-docs at the Melbourne Node. Xue-Fen’s work at the CILR will involve transformation of rice, a plant that is very different to the woody Jinko she has previous experience transforming.

After completing her undergraduate and postgraduate studies at the University of Fudan, in Shanghai, China, Xue-Fen is excited to be working in Australia. “I wanted to get some international experience, either in Australia or in America” Xue-Fan said. “I really like Melbourne, the people are friendly.”

Xue-Fan was born and raised in the south of China, and only moved to Shanghai to study. She misses her family and friends, but getting authentic Chinese food is not a problem at Chinatown on Little Bourke St. Whilst in Australia, Xue-Fan wishes to travel, especially to Australia’s largest city, Sydney.

Congratulations to the following scientist for their recent submissions and/or graduations:

Julia Cremer
Honours Graduation

Femke de Jong
PhD Thesis Submission

Giel van Noorden
PhD Thesis Submission

Joko Prayitno
PhD Thesis Submission

Michael Sheahan
PhD Thesis Submission

Renee Sims
Honours Graduation

Jean (Jiayu) Wen
PhD Thesis Submission