

ARC CENTRE OF EXCELLENCE FOR  
INTEGRATIVE LEGUME RESEARCH

annualreport

2003



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# CILR Annual Report

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# 1. Introduction to the Centre

... direct impact on  
 agricultural  
 sustainability,  
 environmental quality  
 and potential value-  
 added products for  
 human health

The ARC Centre of Excellence for Integrative Legume Research (CILR) is a partnership that brings together leading plant researchers located at the University of Queensland, the Australian National University, the University of Melbourne and the University of Newcastle. The director of the Centre is Professor Peter Gresshoff (who is also Professor of Botany in the School of Life Sciences at UQ). The Centre aims to drive further development of the genomics and phenomics of legumes, providing the critical mass of human, intellectual and infrastructure resources to function as a world-class research centre.

The Centre has been established with a \$10 million Australian Research Council (ARC) grant over five years from 2003. Cash contributions from partner universities and state governments matching the ARC funding, combined with in-kind contributions of staff and facilities will generate a major \$28 million five-year biological science research effort.

Research in the Centre will provide critical insights into mechanisms of organ differentiation and intercellular communication, utilising comparative genomics on the internationally acknowledged model legumes *Lotus japonicus* (*Lj*) and *Medicago truncatula* (*Mt*). New knowledge of plant growth and development processes through mechanistic analysis of organ induction will provide the tools to optimise legume productivity, quality, and environment adaptation. This in turn will have direct impact on agricultural sustainability, environmental quality and potential value-added products for human health.

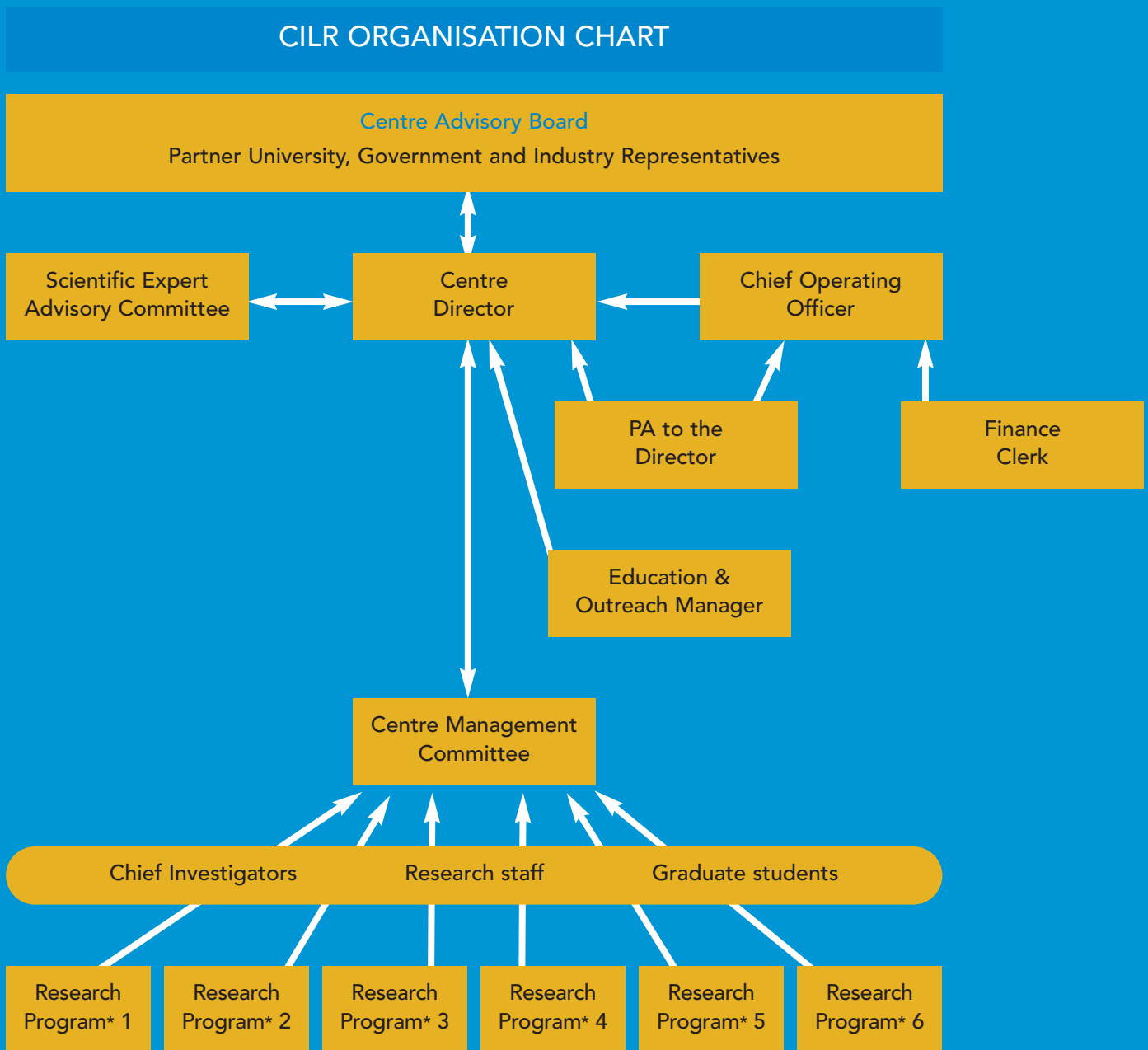
The Centre's research initiatives have significant intellectual property commercialisation potential, and this will augment Australia's international standing in scientific discovery and directly benefit the Australian economy.

The Centre's internal organisational linkages are outlined in the chart in Figure 1.



Chief Investigators and Chief Operating Officer at their quarterly meeting Canberra November 2003

Figure 1



*\*Research Programs*

1. Meristem formation in somatic embryogenesis
2. Communication between meristems
3. Discovery of peptide signalling molecules
4. Legume root nodule meristems and their regulation
5. Shoot apical and floral meristems and their regulation
6. Gene networks in the intact plant



## 2. Director's Report



*Prof Gresshoff, Dr Djordjevic, Prof Rolfe and Dr Weinman celebrate the ARC announcement 12th December 2002*

*I am proud to be associated with such a talented group of scientists and support staff who have a common goal and mission, together with a commitment and excitement that comes from researching a frontier of biological science*

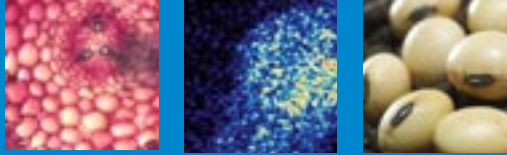
The first year of our Centre saw an incredible amount of integration of research and discovery programs based on previous scientific momentum of the partners. Considerable effort was applied to developing common and synergistic research fields. We started to learn more about the complexities of research areas in each of our nodes and contributed constructively to new perspectives of analysis and interpretation. Indeed 'the whole became more than the sum of its parts'.

After the initial euphoria of the Centre award in December 2002, we held our first Annual Symposium at the UQ Moreton Bay Research Station on Stradbroke Island in late February 2003. The meeting was structured along 'Gordon Conference' lines to facilitate interaction, creativity and planning (and also some fun). All Chief Investigators, postdoctoral researchers, graduate and honours students, and key technical staff were invited to participate in the three day meeting. All scientific attendees presented overviews of their research and discussed how these would fit into the Centre's mission and research goals, focussing on meristems, their control and communication.

Additionally we were privileged to be joined by Professor Doug Cook (UC Davis and member of our Scientific Expert Advisory Committee) who proved to be a valuable contributor by providing an international benchmarking focus in the nodulation and plant genomics area and expert facilitation of research discussion. Representatives of commercial companies in both biotechnology and seed production attended to provide a 'real world' perspective. Professor Peter Langridge, from the Australian Centre for Plant Functional Genomics (also a member of our SEAC), attended and provided valuable linkage between our two centres of molecular plant research.

The Annual Symposium initiated the now-established pattern of quarterly Chief Investigator meetings that deal more specifically with internodal linkages, research coordination and definition of research priorities. During 2003, three such meetings were held in Melbourne, Newcastle, and Canberra. These meetings are restricted to the Chief Investigators, the Chief Operating Officer and guests, usually representing new linkages. Their benefit is easily measured by the increasing quality and depth of discussion, coupled with the transition from abstract research plans to actual seamless research facilitation.

While the focus of the Centre is on the development and interaction of meristematic growth centres in plants, coupling analyses at the DNA, RNA, protein and metabolite level with the phenotypic characteristics, the Centre is excellently positioned to establish innovative linkages with other legume research programs. In 2003 links were established with two leading plant research groups in Australia; (1) Professor Jim Reid and Dr John Ross at the University of Tasmania (known for their flowering and hormonal analyses of pea) and (2) Professor Craig Atkins at the University of Western Australia (known for his pioneering work in lupin biochemistry and physiology). In both cases the interaction is facilitated through the Centre's support of a postgraduate student in a research topic related to the 'meristem communication' theme. In the case of Western Australia the CILR's support for the research contributed to a successful ARC discovery grant to Professor Atkins.



Research momentum was maintained in the Centre as evidenced by publication of our work in leading journals. (see page 8) The ANU node published work on bacterial quorum sensing compounds and their influence on plant gene expression in *PNAS*; the Newcastle node produced a fundamentally important paper on *Medicago truncatula* *SERK* (specific embryo receptor kinase) in *Plant Physiology*; and the UQ node published two seminal papers on legume gene discovery in *Science* (for the nodulation receptor kinase NARK of soybean) and *Genes & Development* (for the pea RMS1 branching gene). New students, research staff and visitors joined the Centre further enriching our already international mix. As director I welcome this internationalism, as it provides us with different perspectives as well as new challenges, and truly represents the nature of our science.

The Centre also formally established itself as a structure following completion of the contract with the ARC in June. Core additional laboratory and research facilities were approved for UQ and Newcastle and renovation is currently in process. We appointed key administrative and support staff, especially Mr Ian Harris as Chief Operating Officer, and Ms Melisa Lewins as Personal Assistant to the Director. Financial, reporting and IT infrastructure systems were established. Together with the soon to be appointed Education and Outreach Manager these positions form a common resource for the entire Centre and our interacting community.

While recognising that quantity does not necessarily equate to quality, a recent count of CILR staff members and graduate students was about 80. However, the Centre's staff is of the highest quality as demonstrated by the academic standing of our students, graduation rates, employment opportunities, the experience of postdoctoral staff, and the quality of publications. I am proud to be associated with such a talented group of scientists and support staff who have a common goal and mission, together with a commitment and excitement that comes from researching a frontier of biological science.

We have a vision and a quest; that is to understand how a multicellular organism manages to develop the complexity of functions given only one genome of perhaps 30,000 genes. How do cells differentiate? How do they control their cell proliferation, and how do they communicate? We continue to assert that the analysis of plant developmental processes in an integrative fashion incorporating a balance of reductionist science and Systems Biology, allows us to contribute to paradigm shifts that will be relevant not only to plant biology but to all living organisms on this planet.

I trust that you the readers of this report, will gain additional insight into the Centre's activities, perspectives, and goals and we welcome contact for further enquiry.

Peter M. Gresshoff  
**Director, CILR**  
**March 2004**

*The Annual  
Symposium initiated  
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pattern of quarterly  
Chief Investigator  
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more specifically  
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coordination and  
definition of  
research priorities*

# 3. Centre Advisory Board & Scientific Expert Advisory Committee

The Centre is privileged to have so many highly respected government, industry, scientific and university leaders who have made a significant commitment to the development of the Centre by agreeing to serve on the Centre Advisory Board and the Scientific Expert Advisory Committee. We look forward to their valuable contribution and guidance as the Centre works to achieve its research goals.

The **Centre Advisory Board** will provide advice on the development of strategies and vision for the future of the Centre, and its direction in finance and scientific management, commercialisation and IP management.

The members of the Centre Advisory Board are:

**Professor David Siddle**

Deputy Vice Chancellor (Research)  
University of Queensland  
BRISBANE

**Professor Ron McDonald**

Deputy Vice Chancellor (Research)  
University of Newcastle  
NEWCASTLE

**Professor Frank Larkins**

Deputy Vice Chancellor (Research)  
University of Melbourne  
MELBOURNE

**Professor Lawrence Cram**

Deputy Vice Chancellor (Research)  
Australian National University  
CANBERRA

**Dr Jaydeep Biswas**

School of Engineering  
University of Queensland  
BRISBANE

**Dr Bruce Wicking**

Consultant  
MELBOURNE

**Dr John Manners**

Program Leader  
CSIRO Plant Industry  
BRISBANE

**Professor Dick Wettenhall**

Director, BIO21  
University of Melbourne  
MELBOURNE

**Ms Paula Fitzgerald**

Executive Manager  
Agrifood Awareness Australia  
CANBERRA

**Professor Peter Langridge**

Director  
Australian Centre for Plant Functional Genomics  
University of Adelaide  
ADELAIDE

**Dr Bill Silvey**

Director,  
Competitive R&D Investment Programs  
Dept of State Development and Innovation  
BRISBANE

The **Scientific Expert Advisory Committee** will advise the Centre Director on the direction of research, educational programs undertaken within the Centre and provide leadership in the Centre's annual research conference.

The members of the Scientific Expert Advisory Committee are:

**Professor Doug Cook**

Department of Plant Pathology  
University of California at Davis  
USA

**Dr Noel Ellis**

Department of Crop Genetics  
John Innes Centre  
UK

**Professor Ueli Grossnikolaus**

Institute of Plant Biology  
University of Zurich  
SWITZERLAND

**Professor Erwin Herble-Bors**

Institute of Microbiology &  
Genetics  
University of Vienna  
AUSTRIA

**Professor John Irwin**

CRC for Tropical Plant Protection  
University of Queensland  
AUSTRALIA

**Professor Minoru Kanehisa**

Bioninformatics Centre  
Institute for Chemical Research  
Kyoto University  
JAPAN

**Professor Adam Kondorosi**

Institute des Sciences Du Vegetal  
Gif-Sur-Yvette  
FRANCE

**Professor John Mattick**

Institute of Molecular Biosciences  
University of Queensland  
AUSTRALIA

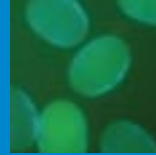
**Dr Satoshi Tabata**

Kazusa DNA Research Centre  
JAPAN

**Professor Carroll Vance**

Plant Science Research Centre  
University of Minnesota  
USA





## 4. Research Highlights

Despite the fact that the Centre only formally came into being with the signing of the contract between the University of Queensland (as the lead institution) and the ARC in June 2003, we are proud to report on a number of significant research outcomes from the laboratories of the Centre's Chief Investigators.

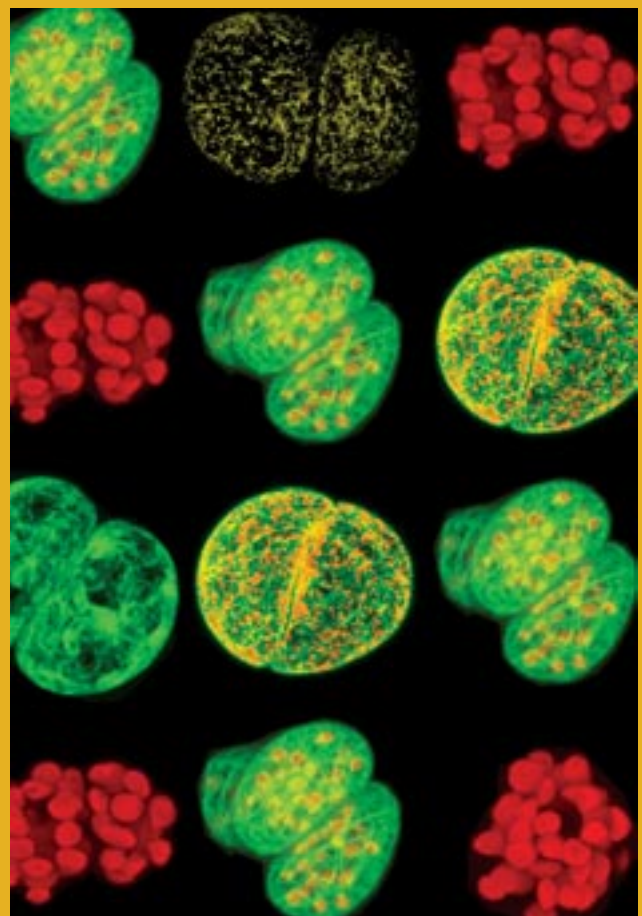
**Professor Peter Gresshoff and Dr Bernie Carroll** set the tone for the year with the publication in *Science* of their paper on 'Long-distance signaling in nodulation directed by a CLAVATA1-like receptor kinase'. This paper was cited in the Faculty of 1000 Biology Reports, which highlight the world's most interesting papers in biology, (<http://www.facultyof1000.com/start.asp>). The evaluators said the paper provided '...the first intriguing molecular insight into the autoregulatory signal transduction pathway'

**Associate Professor Ray Rose** and his group in Newcastle cloned a *Somatic Embryogenesis Receptor Kinase (SERK)* gene from *Medicago truncatula (MtSERK1)* and examined its expression in culture using real time PCR. Although the analyses suggest that *MtSERK1* is comparable to *AtSERK1*, (which in *Arabidopsis* is involved in somatic embryogenesis), in legumes *MtSERK1* may have a broader role in morphogenesis in cultured tissue, rather than being limited to somatic embryogenesis. The group had their paper 'MtSERK1 cloning and expression analysis in embryogenesis' published in September in *Plant Physiology*.

From the ANU node, **Dr Uli Mathesius** and **Professor Barry Rolfe** had their work on 'Extensive and specific responses of a eukaryote to bacterial quorum-sensing signals' published in the *Proceedings of the National Academy of Sciences USA (PNAS)*. Results indicated that eukaryotes have an extensive range of functional responses to AHLs (signals) that may play important roles in the beneficial or pathogenic outcomes of eukaryote-prokaryote interactions.

**Dr Christine Beveridge** has had a longstanding and active collaboration with colleagues in the Institut National de la Recherche Agronomique-France (INRA) and at the University of York (UK) and an important outcome of this collaboration was the publication of their paper 'MAX4 and RMS1 are orthologous dioxygenase-like genes that regulate shoot branching in *Arabidopsis* and pea' in *Genes and Development*. The research reported in this paper may provide the opportunity for discovery of a novel plant hormone that regulates shoot branching.

**Dr Michael Djordjevic** and **Dr Georg Weiller** also published an extensive proteome of a *Rhizobium* bacterium, *Sinorhizobium meliloti* in the *Journal of Molecular Plant-Microbe Interactions*. This is the first time that such an extensive proteome analysis had been done on *Rhizobium* and has shown a number of novel proteins not predicted in the DNA sequence. In addition, they identified many genes expressed in the symbiotic bacteria isolated from root nodules that were not present in bacterial cells grown in laboratory media.



# 5. Publications

The Centre's focus is on scientific discovery and as such we aim to publish regularly in high impact journals, as appropriate to the research that is being reported. In this way we can maximise our communication of the work of the Centre to the international scientific community.

**Beveridge C.A., Gresshoff P.M.,** Rameau C., Turnbull G.C.N. (2003) "Additional signalling compounds are required to orchestrate plant development." *J Plant Growth Reg.* **22**: 15-24.

**Beveridge C.A.,** Weller J.L., Singer S.R., Hofer J.M.I. (2003) "Axillary meristem development. Budding relationships between networks controlling flowering, branching, and photoperiod responsiveness." *Plant Physiology* **131**: 927-934.

**Bhalla P.L.** (2003), "Genetic engineering of pollen allergens for hayfever immunotherapy." *Expert Review of Vaccines* **2**: 89-98.

Chapman A., Pantalone V.A., Ustan A., Allen F.L., Landau-Ellis D., Trigliano R.N., **Gresshoff P.M.** (2003). "Quantitative trait for loci for agronomic and seed quality traits in an F2 and F4:6 soybean population." *Euphytica* **129**: 387-393.

Chen H., Teplitski M., Robinson J.B., **Rolfe B.G.,** Bauer W.D. (2003) "Proteomic analysis of wild-type *Sinorhizobium meliloti* responses to N-Acyl homoserine Lactone quorum-sensing signals and the transition to stationary phase." *J Bacteriology* **185**: 5029-5036.

**Djordjevic M.A.,** Chen H.C., Natera S., van Noorden G., Menzel C., Taylor S., Renard C., Geiger O., the *Sinorhizobium* DNA sequencing Consortium and **Weiller G.F.** (2003) "A global analysis of protein expression profiles in *Sinorhizobium meliloti*: Discovery of new genes for nodule occupancy and stress adaptation." *Molecular Plant-Microbe Interactions* **16**: 508-524.

Ferguson, B.F., **Mathesius U.** (2003) "Signaling interactions during nodule development." *J. Plant Growth Regul.*, **22**: 47-72.

Godwin R. M., Rae A.L., **Carroll B.J.,** Smith F.W. (2003). "Cloning and characterization of two genes encoding sulfate transporters from rice (*Oryza sativa* L.)." *Plant and Soil* **257**: 113-123.

**Gresshoff P. M.** (2003) "Post-genomic insights into plant nodulation symbioses." *Genome Biology* **4**: 201.

**Gresshoff P.M.** (2003) "ARC Centre of Excellence for Integrative Legume Research puts focus on plant functional genomics." *Australasian Biotechnology* **13**: 2.

**Gresshoff P.M., Rose R.J., Singh M.B. and Rolfe B.G.,** (2003) "Symbiosis signals." *Today's LifeScience* May/Jun.

Kerim T., Imin N., Weinman J.J., **Rolfe B.G.** (2003) "Proteome analysis of male gametophyte development in rice anthers." *Proteomics* **3**: 738-751.

Kerim T., Imin N., Weinman J.J., **Rolfe B.G.** (2003) "Proteomic analysis reveals developmentally expressed rice homologues of grass group II pollen allergens." *Functional Plant Biology* **30**: 843-852.

Matamoros M.A., Clemente M.R., Sato S., Asamizu E., Tabata S., Ramos J., Moran J.F., Stiller J., **Gresshoff P. M.,** and Becana M. (2003) "Molecular analysis of the pathway for the synthesis of Thiol Tripeptides in the model legume, *Lotus japonicus*." *Molecular Plant-Microbe Interactions* **16**: 1039-1046.

**Mathesius U.** (2003) "Signalling pathways between roots and soil microbes – a comparison of the *Rhizobium*-legume symbiosis with plant-arbuscular mycorrhizal and plant nematode interactions." *Plant and Soil* **255**: 105-119.

**Mathesius U.,** Mulders S., Gao M., Teplitski M., Caetano-Anolles G., **Rolfe B.G.,** Bauer W.D. (2003) "Extensive and specific responses of a eukaryote to bacterial quorum-sensing signals." *Proceedings National Academy Sciences* **100**: 1444-1449.

**Mathesius U.,** Imin N., Natera S.H.A., **Rolfe B.G.** (2003) "Proteomics as a functional genomics tool." *Methods in Molecular Biology 236: Plant Functional Genomics: Methods and Protocols.* Edit Grotewold E.: 395-413, Humana Press Inc., Totowa, NJ, USA.



Men A.E., Laniya T.S., Searle I.R., Iturbe-Ormaetxe I., Gresshoff I., Jiang Q., **Carroll B.J.**, **Gresshoff P.M.** (2003). "Fast neutron mutagenesis of soybean (*Glycine soja* L.) produces a supernodulating mutant containing a large deletion in linkage group H." *Genome Letters* **1**: 1-9.

Nolan K.E., Irwanto R.R., **Rose R.J.** (2003) "Auxin up-regulates *MtSERK1* expression in both *Medicago truncatula* root-forming and embryogenic cultures." *Plant Physiology*, **133**: 218–230.

Peace C., Vithanage V., Turnbull C., **Carroll B.J.** (2003) "A genetic map of macadamia based on radiolabelled DNA amplification fingerprinting." *Euphytica* **134**: 17-26.

**Rolfe B.G.**, **Mathesius U.**, **Djordjevic M.A.**, **Gresshoff P.M.** (2003) "11th International Congress on Molecular Plant-Microbe Interactions held at St. Petersburg - a report." *Indian Journal of Experimental Biology* **41**: 1205-1208.

**Rolfe B.G.**, **Mathesius U.**, **Djordjevic M.A.**, Weinman J.J., Hocart C., **Weiller G.**, Bauer W.D. (2003) "Proteomic analysis of legume-microbe interactions." *Comparative and Functional Genomics* **4**: 225-228.

Searle I.R., Men A.E., Laniya T.S., Buzas D.M., Iturbe-Ormaetxe I., **Carroll B.J.**, **Gresshoff P.M.** (2003) "Long distance signalling for nodulation control in legumes requires a *CLAVATA1*-like receptor kinase." *Science* **299**: 109-112.

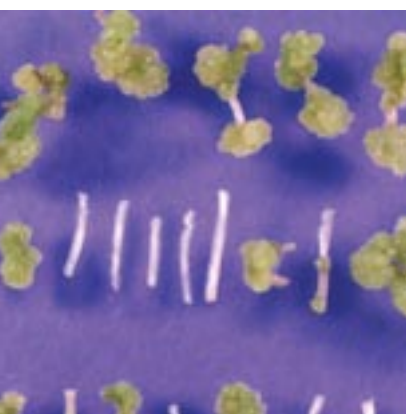
**Singh M.B.**, **Bhalla P.L.** (2003), "Hypoallergenic derivatives of major grass allergens for allergy vaccination." *Immunology and Cell Biology* **81**: 86-91.

Singh M., **Bhalla P.L.**, Xu H., **Singh M.B.** (2003), "Isolation and Characterization of a Flowering Plant Male Gametic Cell-Specific Promoter." *FEBS Letters* **542**: 47-52.

Sorefan K., Booker J., Haurogne´ K., Goussot M., Bainbridge K., Foo E., Chatfield S., Ward S., **Beveridge C.**, Rameau C., Leyser O. (2003) "MAX4 and RMS1 are orthologous dioxygenase-like genes that regulate shoot branching in *Arabidopsis* and pea." *Genes and Development* **17**: 1469–1474.

Vickers C., Xue G.P., **Gresshoff P.M.** (2003) "A synthetic xylanase as a novel reporter in plants." *Plant Cell Rep* **22**: 135-140.

# 6. Staff and Students



The staff and students at each of the nodes of the Centre as at 31 December 2003 are listed below. The total was 58 and this is anticipated to grow to 95 when the Centre is fully operational by mid 2004.

## CILR STAFF & STUDENT LIST 2003

### UNIVERSITY OF QUEENSLAND

Prof Peter M. Gresshoff	Director	Director.cilr@uq.edu.au
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Dr Christine Beveridge	Chief Investigator	c.beveridge@botany.uq.edu.au
Dr Bernie Carroll	Chief Investigator	b.carroll@uq.edu.au
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### UNIVERSITY OF MELBOURNE

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Assoc Prof Prem Bhalla	Chief Investigator	premlb@unimelb.edu.au
Dr Takashi Okada	Post Doc	t.okada@landfood.unimelb.edu.au
Anzu Okada	Research Assistant	anzu@unimelb.edu.au

## UNIVERSITY OF NEWCASTLE

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Rina Irwanto	PhD Student	Rina.irwanto@studentmail.newcastle.edu.au
Michael Sheahan	PhD Student	Michael.sheahan@studentmail.newcastle.edu.au
Xin-Ding Wang	Senior Research Assistant	bixdw@alinga.newcastle.edu.au
Yoko Nitanaï	Research Assistant	Yoko.nitanaï@newcastle.edu.au
Nikki Legge	Research Assistant	Nicole.legge@newcastle.edu.au

## AUSTRALIAN NATIONAL UNIVERSITY

Prof Barry G. Rolfe	Chief Investigator	rolfe@rsbs.anu.edu.au
Dr Georg Weiller	Chief Investigator	gweiller@rsbs.anu.edu.au
Prof Chris Parish	Chief Investigator	Christopher.Parish@anu.edu.au
Dr Michael Djordjevic	Chief Investigator	michael@rsbs.anu.edu.au
Dr Ulrike Mathesius	Chief Investigator	Ulrike.mathesius@anu.edu.au
Dr Nijay Imin	Post Doctoral Fellow	Imin@rsbs.anu.edu.au
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Dr Mary Skotnicki	Visiting Scientist	skotnicki@rsbs.anu.edu.au
Dr Hiroto Naora	Visiting Scientist	naora@rsbs.anu.edu.au
Dr Prudy Hall	Visiting Scientist	Hall@rsbs.anu.edu.au
Charles Hocart	Senior Tech Officer	Hocart@rsbs.anu.edu.au
Marie Oakes	Senior Tech Officer	oakes@rsbs.anu.edu.au
Angela Morris	PhD Student	morris@rsbs.anu.edu.au
Femke De Jong	PhD Student	dejong@rsbs.anu.edu.au
Giel Van Noorden	PhD Student	vannoorden@rsbs.anu.edu.au
Joko Prayitno	PhD Student	prayitno@rsbs.anu.edu.au
Anne Mackenzie	Tech Officer	Mackenzie@rsbs.anu.edu.au
Elena Gärtner	Tech Officer	gartner@rsbs.anu.edu.au
Hancai Chen	Tech Officer	hcchen@rsbs.anu.edu.au
Jeremy Weinman	Tech Officer	weinman@rsbs.anu.edu.au
Kerong Zhang	Tech Officer	kzhand@rsbs.anu.edu.au

# 7. Collaborations and Outreach

The Centre recognises that with the rapid rise of the genomics and phenomics revolution, and dramatically improved communication systems, good science depends on effective collaboration. As a newly established Centre with a primary objective to keep at the forefront of discovery in plant development, we have applied resources from day one to growing tangible collaborations with other top quality organisations and research groups both in Australia and overseas. In 2003 these collaborations included:

- **Institute National de la Recherche Agronomique, Versailles France**

Dr Catherine Rameau

Major contributor to the vegetative axillary meristem project. Co-supervision and student and researcher exchanges, sharing genetic resources, intellectual property and ideas. An important link to the EU Legume Project and to several important resources provided therein.

- **Department of Plant Biology, University of Minnesota, USA**

Prof Kathryn VandenBosch

Three month sabbatical visit by Assoc Prof Ray Rose; joint funding with Prof Carroll Vance of a protoplast transformation project which could serve the basis for a high throughput transformation system with the capability of producing large numbers of T-DNA insertional mutants; Dr Michael Djordjevic submitted a joint grant proposal with Prof VandenBosch to the NSF of the USA.

- **School of Plant Science, University of Tasmania**

Prof Jim Reid, Dr Jim Weller, Dr John Ross

The legume group at this institution has had continuous ARC funding for research on plant development for over 30 years. A PhD student at UTAS is now jointly funded and supervised by CILR. Future CILR projects will benefit from the screening of novel developmental mutants by this group.

- **Institute of Molecular Biosciences UQ**

Comparative and Computational Genomics Group

Investigations of sequence motifs responsible for DNA deletion with Dr Georg Weiller.

- **Carleton College Northfield, MN USA**

Prof Susan R. Singer

Joint supervision of CILR PhD student and is providing data for incorporation into garden pea flowering model.

- **Bureau of Sugar Experiments Stations Indooroopilly Queensland**

Dr Prakash Lakshmanan

Assisting with the comparative genetics of *RMS1*.

- **CRC for Tropical Plant Protection.**

Dr Christine Beveridge is facilitating joint work on a research grant for a mutational approach to the discovery of recognition and signalling genes that control compatibility between soybean and *Phytophthora*. Dr Bernie Carroll is also collaborating with Dr David Jones (ANU) on the map-based cloning of a *Fusarium* wilt resistance gene.

- **Centre National de la Recherche Scientifique, Gif-sur-Yvette France**

Dr Martin Crespi

Detailed transcriptome analysis of *Medicago truncatula* plants that overexpress ENOD40, a major regulator of meristem activity in plants.



- **CRC for Sugarcane Industry Innovation Through Biotechnology.**

Dr Christine Beveridge and Dr Bernie Carroll are also Chief Investigators for this CRC, and accordingly CILR is contributing significant genetic and other in-kind resources in a program to meet industry objectives of improving sugarcane yield.

- **School of Biochemistry & Molecular Biology (BaMBI), Australian National University**

Dr Barry Pogson

Joint ARC Discovery grant with Dr Christine Beveridge. CILR is providing genetic and other in-kind resources. Research funded through this grant may yield information that CILR can use to meet its objective of discovery of novel long-distance signals.

- **School of Molecular and Microbial Biosciences, University of Sydney**

Prof Jenny Brand-Miller

Strategies to promote the utilisation of legumes in low glycaemic index (GI) diets, promoting better health and improved quality of life in ageing.

- **Sanitarium Health Foods, Avondale NSW**

Strategies to promote the utilisation of legumes in food for better health and improved quality of life in ageing.

- **Plant Biology (Botany), University of Western Australia**

Prof Craig Atkins. A PhD student at UWA is funded and jointly supervised by CILR. The project will focus on using techniques developed within CILR for the screening of regulatory genes in lupin mutants.

- **Faculty of Arts, University of Queensland**

The CILR and the Faculty are jointly funding research into public perceptions and ethical issues surrounding the development of genetically modified organisms (GMOs). This includes the enrolment of two PhD students who are jointly supervised by Prof Peter Gresshoff, and Assoc Prof William Grey, the Centre's bio-ethics advisor.

Dr Uli Mathesius was a finalist in the Fresh Science competition, which involved presenting to the public during National Science Week in Melbourne in August 2003. Following the competition an article was published in the Sydney Morning Herald on 28th August, 2003.

## Bacteria fooled by a secret life of plants

Deborah Smith  
Science Writer

Bacteria like to hunt in packs, and are in constant communication with each other so they can work out when they have amassed enough troops to launch an attack.

But if it's a plant they're plotting against, the microbes face a very cunning foe.

Australian researchers have discovered that plants can eavesdrop on the battle talk of bacteria under the soil and mimic their communication signals in apparent attempts to thwart their offensives.

Ulrike Mathesius, of the Australian National University, said plants had a sophisticated surveillance and response system.

They were able to distinguish between harmful and beneficial bacteria.

And by mimicking the bacteria's signals they could trick a small group of their enemy into thinking they had the numbers, so they struck prematurely.

"Other signals can stop an attack," said Dr Mathesius, who presented the team's findings yesterday in Melbourne at Fresh Science 2003, a forum for young Australian researchers.

An American member of the team discovered several years ago that bacteria communicate by emitting tiny amounts of chemicals. When their numbers swell and the concentration of chemicals reach high enough levels, genes in the bacteria, such as those controlling aggressive behaviour, are switched on.

"But no one knew for certain whether plants could actually detect bacterial small talk and act accordingly," Dr Mathesius said.

To find out, she exposed the roots of an alfalfa-like plant to different amounts of chemicals from good and bad soil bacteria and simultaneously monitored changes in the levels of 2500 proteins produced by the plants.

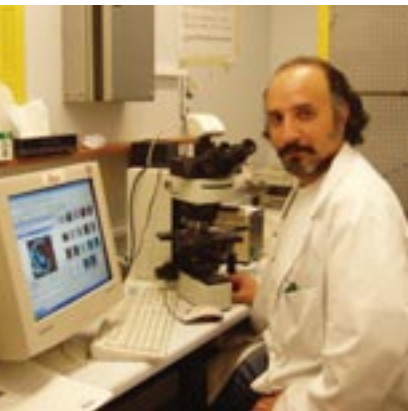
More than 150 proteins were affected, many of which were involved in the plant's defence mechanism. Reactions differed according to the threat posed by the bacteria. The plants also secreted compounds similar to the bacteria's communication chemicals.

"We didn't expect such an extensive response," Dr Mathesius said. "If you see a plant, it doesn't seem to do very much. But there is so much going on under the soil. It's like finding that instead of being blind it can see and hear and talk."

The researchers hope their findings will lead to improved ways to prevent diseases in plants. One option would be to spray crops with the bacterial chemical signals to confuse attackers.

It might also be possible to breed plants that could send out the confusing signals themselves, she said.

# 8. Visitors to the Centre & Visits to overseas Institutions



## Visitors to the Centre

### To the ANU Node:

**Prof Eric Triplett**

University of Florida, FL USA  
(January - July)

**Prof W. D. Bower**

Ohio State University, Ohio USA  
(May)

**Prof Prudence Hall**

Hiram College, Ohio USA  
(July - December)

**Prof Xu Zhihong**

President  
Peking University  
(December)

### To the UQ Node:

**Prof Joe Cowles**

Department of Biochemistry  
Virginia Tech Blacksburg, VA USA  
(April – June)

**Mr Pat Bell**

Program Director, Science Research and Innovation

**and Dr Bill Silvey**

Director, Competitive R&D Innovation Programs  
Department of Innovation and the Information Economy  
Queensland Government  
(December)

**Dr Catherine Rameau**

Program Leader  
INRA Station de Genetique et d'Amelioration des Plantes, France  
(December)

**Prof Susan R. Singer**

Carleton College Northfield, MN USA  
(December)

### To the Melbourne Node:

**Prof Kinya Tokiyama**

Tohoku University  
(August – December)

**Prof Scott Russell**

University of Oklahoma USA  
(November – December)



# Visits to overseas institutions

## Assoc Prof Prem Bhalla

- Station de Genetique et d'Amelioration des Plants  
INRA France  
Seminar presented: Regulatory mechanisms controlling male gamete specific gene expression in flowering plants.
- Dept of Pathophysiology University of Vienna, Austria  
Seminar presented: Biotechnological approaches for reduction of grass pollen allergenicity.

## Dr Bernie Carroll

- Institute of Plant Biology, University of Zurich Switzerland  
Seminar presented: Short and long-distance signalling in plant development.
- Chinese and Shanghai Academy of Sciences, Shanghai, Peoples Republic of China  
Seminars presented: Short and long-distance signalling in plant development and Application of molecular biotechnology to genetic improvement of crops.

## Prof Peter Gresshoff

- Biomaterials Science & Engineering, and Department of Biology, Massachusetts Institute of Technology, USA  
Seminar presented: Functional genomics of systemic regulation of cell division.
- Department of Plant and Soil Sciences, University of Delaware USA  
Seminar presented: Molecular genetics of nodule formation.
- Crop Genetics Research & Development Division – DuPont, Delaware USA

## Assoc Prof Ray Rose

- Department of Plant Biology, University of Minnesota, USA  
Three month sabbatical.

## Assoc Prof Mohan Singh

- Station de Genetique et d'Amelioration des Plants  
INRA France  
Seminar presented: Molecular biology and immunology of grass pollen allergens.
- Institute of Plant Biology, University of Zurich Switzerland  
Seminar presented: Male gamete specific gene expression in flowering plants.
- Biological Research Centre, HAS EU Centre of Excellence Hungary  
Seminar presented: Molecular biology of male gametogenesis and fertilization in flowering plants.
- Botany Department, University of British Columbia Canada  
Seminar presented: Male gamete specific gene expression in flowering plants.



## 9. Intellectual Property

*Research planning has centred on setting up projects in line with the six research programs outlined in our initial application to the ARC.*

The Centre has given priority to best practice management of intellectual property that will be generated by research undertaken within the Centre. To this end, all staff and students have been required to sign confidentiality and assignment of IP agreements.

Work has already been done to develop the infrastructure, strategies and policies for commercialisation of IP, laying the groundwork to maximise our capacity to respond to opportunities arising out of significant discoveries and new technologies. Working with UniQuest, the commercialisation arm of UQ, we have registered the business name of MERISTOMICS, and an appropriate entity will be established by the partner universities as a vehicle for commercialising IP in the future.

An international patent application was lodged in October for the regulation of cell division and plant nodulation, based on the legume gene discovery reported in *Science*.



# 10. Future Directions and Priorities

Going in to 2004, the foundations are well set for a rapid increase in the momentum of the Centre on all fronts – research, education and outreach, industry collaboration and national and international linkages.

By the end of 2003 recruitment processes were well advanced for the appointment of additional highly qualified and talented post doctoral fellows at all nodes, and for the Education and Outreach Manager position. Allowing for the normal lead time for individuals to relocate, including several from overseas, the Centre is anticipated to have its full complement of staff in place by June 2004.

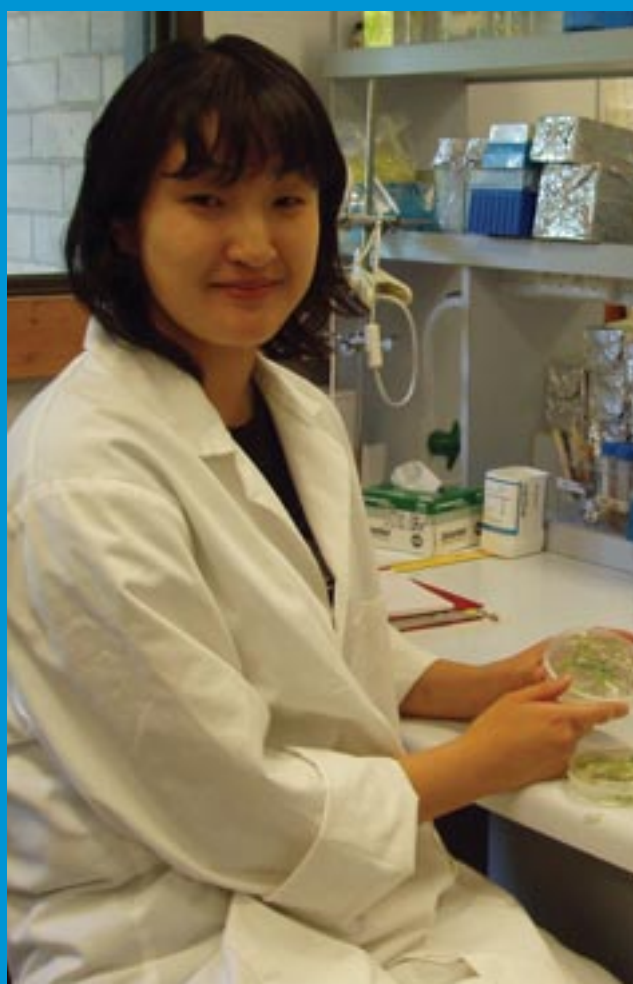
Research planning has centred on setting up projects in line with the six research programs outlined in our initial application to the ARC. A particular focus will be to ensure optimal interaction between the laboratories at each of the nodes, through joint responsibility for specific projects, the exchange of experimental material and extended personal visits by staff and students.

Our research momentum is expected to continue with fascinating discoveries relating to pollen and meristem specific gene expression. We will also conduct an integrative analysis of autoregulation zones on developing soybean roots using transcriptomes, proteome and targeted metabolome analysis. We expect to confirm further recognition of signal substances transported in xylem and phloem. Our pea branching work will be extended with the new definition of functional genes for mutated loci. We hope to develop functional assays for some of the key genes controlling morphogenic processes in legumes, allowing the recognition of biochemical mechanisms. In embryogenesis, the coupling of molecular tools to cell biology will develop an 'atlas' of molecular markers for key transition points between the globular and heart shaped embryo. Integral to this will be our focus on micro-analysis of gene expression in meristems of different origins. Again, as in all biological research, one wonders whether the differences or the similarities will be the most intriguing.

Part of the Centre's work is taking place within the context of significant public debate about the safety and desirability of genetically modified organisms (GMOs).

We recognise and accept our responsibility to make a positive contribution to the debate, not only scientifically, but also from social, political and legal perspectives. To this end the ANU node appointed a science/law graduate, Mr Greg Bodulovic, who has initiated an evaluation of these issues, together with the intellectual property and legal issues, and their implications for the development of GMOs. In addition, the University of Queensland node has appointed Associate Professor William Grey as the Centre's bio-ethics adviser and two PhD students supported through a collaboration with the Faculty of Arts at UQ will undertake studies to assess public perceptions and ethical issues with respect to GMOs.

With the appointment of the Education and Outreach Manager, we will be in a strong position to rapidly extend the Centre's development of educational resources. We will also be formalising links with industry partners who stand to benefit from the Centre's research.



# Financial statement

Statement of operating income and expenditure year ended 31 December 2003

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## INCOME

ARC Centre Grant	2,047,296
State Government Funds	
Queensland (TBC)	
NSW (TBC)	
Host Institutions Cash Contribution	1,040,000

<b>TOTAL INCOME</b>	<b>3,087,296</b>
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## EXPENDITURE

Salaries:	642,824
Equipment:	367,333
Travel:	62,131
Maintenance/Consumables:	342,949
Scholarships	130,384

<b>TOTAL EXPENDITURE</b>	<b>1,545,621</b>
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<b>Funds carried forward to 2004</b>	<b>1,541,675</b>
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# Acknowledgements

The Chief Investigators wish to express their appreciation for the cash and in-kind support provided to the Centre by the following groups:

The Australian Research Council

The Vice-Chancellors and Deputy Vice-Chancellors (Research)  
of the four partner universities.

Faculty of Biological and Chemical Sciences, University of Queensland

School of Molecular and Microbial Sciences, University of Queensland

School of Life Sciences, University of Queensland

School of Land and Food Sciences, University of Queensland

Research School of Biological Sciences, Australian National University

School of Biochemistry and Molecular Biology, Australian National University

John Curtin School of Medical Research, Australian National University

School of Agriculture and Food Systems, University of Melbourne

School of Environmental and Life Sciences, University of Newcastle

*The University of Queensland and the University of Newcastle are also working with the state governments of Queensland and New South Wales respectively, to finalise agreements for support of the Centre.*

## Photographs and Images

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Chris Stacey, University of Queensland

Dr Jiri Stiller, University of Queensland

Qunyi Jiang, University of Queensland

Jeff Wilson, Australian National University

Kim Nolan, University of Newcastle

Assoc Prof Prem Bhalla, University of Melbourne

Gary Cranitch, Queensland Museum

Bruce Cowell, Queensland Museum





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