CILR quarterly electronic update

April 2006

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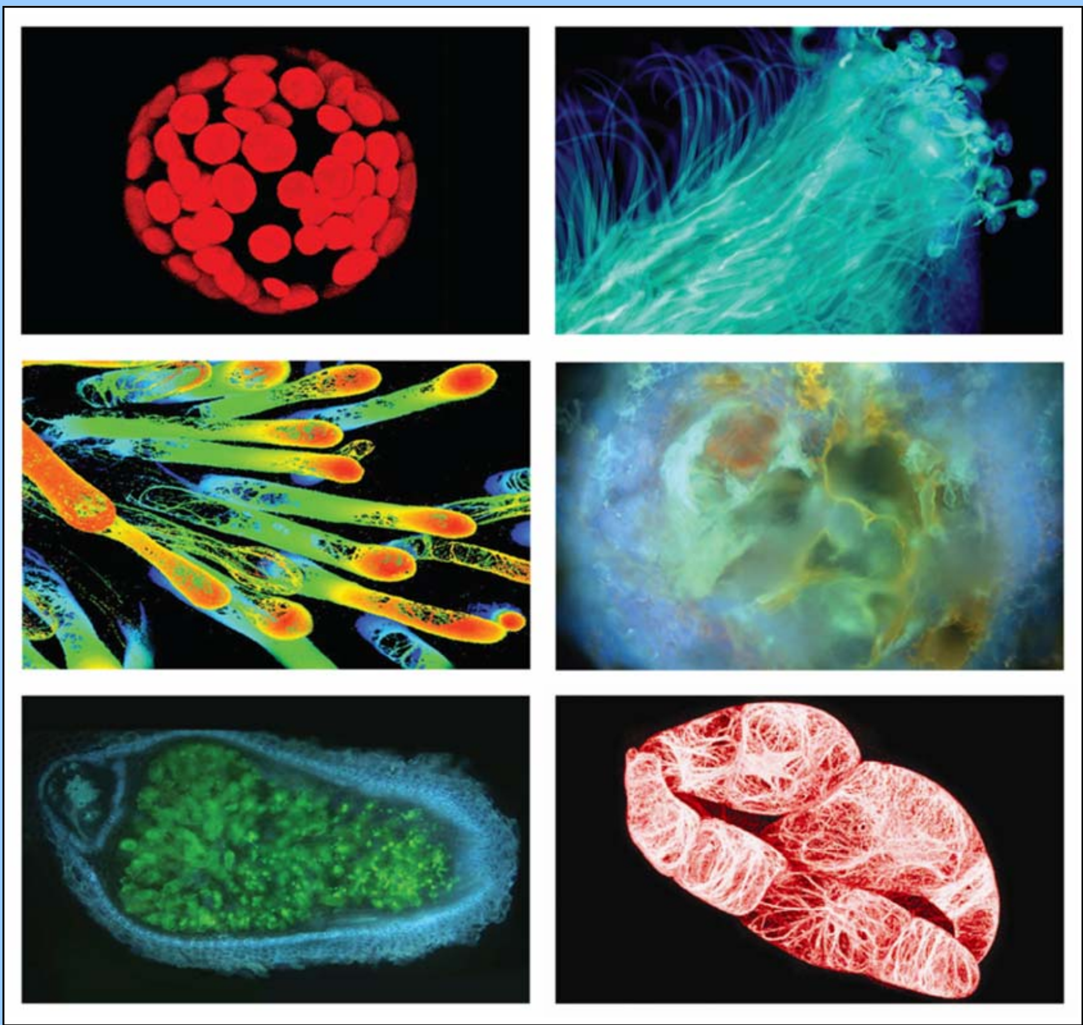
ARC Centre of Excellence for Integrative Legume Research

Special ICLGG3 edition



Welcome to a special print edition of the e-pod
CILR's quarterly electronic newsletter for staff and students...

The CILR is a research network of plant scientists conducting high quality, cutting-edge research into legumes and other plant species. It is headquartered at the University of Queensland (UQ) and has nodes at the Australian National University (ANU), the University of Newcastle (UN) and the University of Melbourne (UM).

Our scientists aim to understand how plant cells communicate, grow and differentiate. Research into plant physiology, molecular and cell biology is providing fundamental insights in to developing enhanced food production, agricultural sustainability, environmental quality and products for human health.

The front cover features a series of six postcards of "unidentified plant objects."
Correct answers for the UPO Quiz can be found at our new website www.cilr.uq.edu.au which goes live at the end of April.

Legume compounds may help cancer treatment

Meristomics CEO Ian Harris (left) talks nodulation with CILR PhD student Arief Indrasumunar (right).

The CILR has lodged a complete patent application for compounds that may be useful in cancer treatment.

CILR researchers screened molecules active during early legume nodulation for biological activity. They identified a number of related compounds which could block angiogenesis (blood vessel formation), and thus potentially prevent the blood supply to tumours.

The research has attracted major international interest for intensive collaboration and joint development. A formal research program is currently underway with French "CSIRO-equivalent" Centre National de la Recherche Scientifique (CNRS). Co-investment discussions are also underway with a New Zealand company.

The CILR formed a commercialisation business "Meristomics" with UniQuest Pty Ltd last October to commercialise plant research discoveries. In a ground-breaking decision, CILR's partner universities (UQ, ANU, UN, UM) passed on their commercialisation rights to Uniquest Pty Ltd, UQ's main commercialisation company.

Meristomics Chief Executive Officer Ian Harris said completion of this patent demonstrated Meristomics as an effective model for commercialisation involving collaboration between multiple partner universities.

"We are now looking to build on this patent success and attract further funding to progress the research," Mr Harris said.

CILR Director Professor Peter Gresshoff said the current research success highlighted the importance of a critical mass of multidisciplinary biological scientists working together.

"The CILR was formed in 2003 through the Australian Research Council (ARC) Centres of Excellence scheme to create the scale and focus required to build on existing research strengths through collaboration and to be internationally competitive.

"Major ARC and Queensland Smart State Government research funding has been vital in building capacity and has enabled this marvellous research outcome," Professor Gresshoff said.

More public funding emphasises the need to spread the word

Australian Research Council (ARC) Chief Executive Officer Professor Peter Hoj has called upon researchers to recognise a responsibility to communicate the importance of their research more effectively.

The move comes after ARC funding for new and ongoing research projects increased 16% on last year to an unprecedented $556.5 million in 2006.

Professor Hoj said the increase in public funding meant that both the ARC and ARC-funded researchers were more accountable to the general public.

"As research funding has risen, there has been an increasing emphasis on demonstrating the return on investment of public funding for research and on evaluating the outcomes of this research," Professor Hoj said in a letter to the Director of the Office of Research and Postgraduate Studies at the University of Queensland in January.

Professor Hoj has urged ARC grant applicants to provide a title and a national benefit summary in accessible language to assist in publicising the crucial importance of research more effectively.

The Federal Government's *Backing Australia's Ability 1 and 2* initiatives are now in full swing. The average size of ARC Discovery and Linkage projects has arisen by 9% from about $274 000 to $299 000. A total of 1,214 new research projects are being funded by the ARC from 2006.

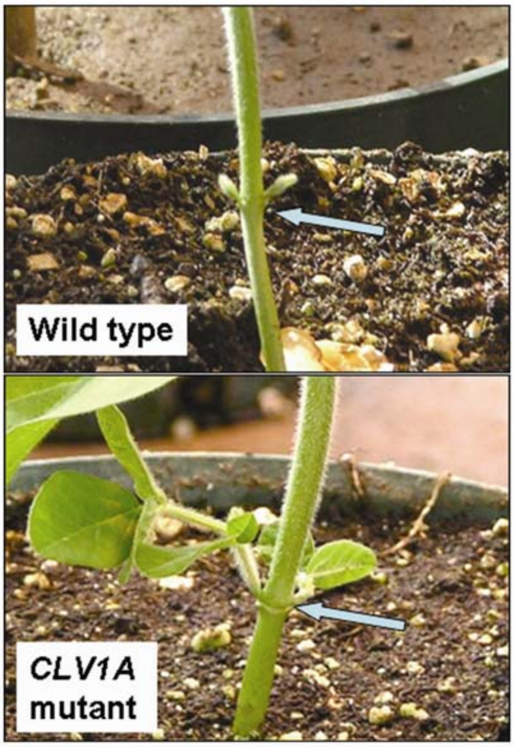
[Note: ARC grants are not subject to "overheads"]

CILR's research has advanced significantly; not only in output volume but in its maturity and depth. Many of our programs are integrating biological processes in legumes. One fascinating example comes from preliminary findings. Soybean *CLAVATA 1A* mutants, derived by the reverse genetics technology called TILLING, show basal node branching (see picture below). This in itself is interesting. But our interest in soybean *CLV1A* stems from the nodulation research project dealing with the autoregulation gene *GmNARK*, whose close relative is *GmCLV1A*. Basal branching *per se* was deemed to be completely within the realm of the branching project headed by Christine Beveridge; suddenly nodulation and branching research overlap.

One notes additional focus on input and output characteristics. Sadly, there is a perception that most of the population is little impacted by research into input traits. Such traits include the water use efficiency of a plant, or the amount of nitrogen fertiliser that is applied, or the amount of insecticide that needs to be sprayed. The reason for this "disinterest" comes from the fact that few of us are farmers but all of us are consumers. I believe the impact of genetically-engineered crop plants was slowed, because the first crops dealt with improvements of input traits; e.g., Round-Up Ready® soybean, Bt corn and cotton.

As consumers we are interested in output traits; a vegetable that tastes better, a grain that lowers blood cholesterol levels, a fruit that prevents the onset of cancer. Many biotechnology firms as well as government scientists are thinking deeply and creatively to develop such applications. Yet, often discovery cannot be forced and needs to rely on serendipity and lateral thinking. Louis Pasteur beautifully stated "Luck favours the prepared mind". We need to be prepared to catch the crumb that flies our way.

The Centre has been lucky. As another example of cross-disciplinary discovery, we have found a molecule involved in *Rhizobium*-legume symbiosis which has biomedical applications. Work headed by Professor Chris Parish at the John Curtin School of Medical Research indicates significant inhibition of blood vessel development (also called angiogenesis) in rat tissues when treated with our compound. A patent (see page 2) has been filed as angiogenesis is a critical component of solid tumour growth in animals. Legume research may have aided our fight against cancer - what a nice dream, and what a good example of the utility of cross-disciplinary and integrative research.



Soybean reverse genetics: TILLING: Wild-type soybean has no branching at cotyledonary node, while TILLED clv1A mutant has branching.

(with Dr Khalid Meksem, SIU)

CILR has also increased its thinking towards output traits. Significantly this has involved the concept of biofuels, especially biodiesel. With increasing crude oil prices and increasing energy demands from developing nations, fuel alternatives are needed. Ethanol production from grains and sugarcane is currently pursued in many countries including Australia. It needs to be recognised that most feed crops for ethanol production are non-legumes and as such require nitrogen fertiliser input. Such fertiliser is usually produced from atmospheric nitrogen gas by the industrial Haber-Bosch process. The large energy requirement has increased fertiliser costs to record heights in parallel with fossil fuel costs. Legumes can eliminate this fertiliser cost if their symbioses with both rhizobia and mycorrhizae are optimised. At present most crop legumes do not fix enough nitrogen, as their physiology is adapted to a non-agricultural habitat, and plant breeding over the last 80 years has overlooked the root system and its processes such as nodulation and water uptake. The Centre is working actively in these areas and has filed two patents. Biomass production, as a function of shoot architecture and seed set are essential, and are part of our research portfolio. Many legumes produce high amounts of protein and vegetable oil in their seed; for example, soybean seed contains

Continued on page 4

40% protein, 20% oil and 30% starch. For pea the protein and oil content are lower but starch is higher. Is it possible to persuade a legume to produce more oil in its leaves? Can we decrease the seed protein content for the benefit of oil content? Which oil is best for biofuels purposes? Can a medic or a clover become an oil producing plant? Perhaps we need to ask such questions when we speak about legumes in the future.

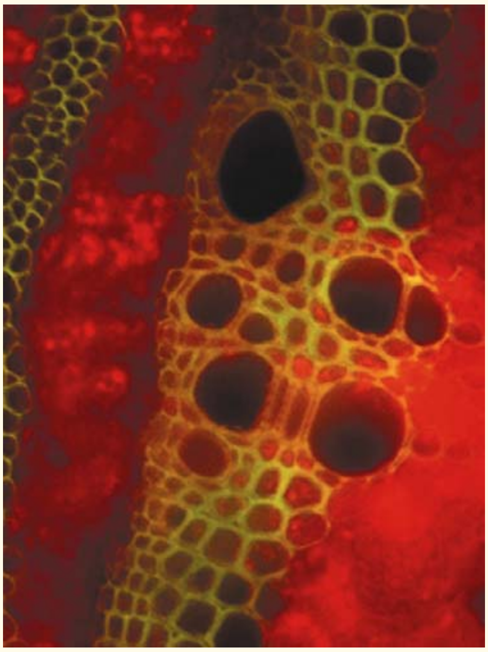
Historically we note that Rudolf Diesel, the inventor of the Diesel engine, powered his first engine with peanut oil. So perhaps we are more than 120 years behind the times when we note the utility of legume oils in this area. Clearly, we now have a chance to catch up, especially with our increased knowledge of legume genomics and biochemistry. Soybean oil is presently converted to make biodiesel, which is used in cities such as Cincinnati to drive city buses. A great environmental benefit - also if you miss the bus, you get the exhaust fumes with the smell of a McDonald's restaurant! As the Centre looks towards our activities beyond the end of 2007, we are focusing on application of our discoveries. We need to define and communicate the vision of our projects and their benefit to the nation and the globe.

The Third International Conference for Legume Genomics and Genetics in Brisbane is an opportunity to further align the research potential of our discipline with future needs. All members of the CILR warmly welcome ICLGG3 participants who have come from around the globe. The CILR sees itself as part of an international community aiming to advance the utility of legumes in our world: as the Centre's initial motto says: Legumes: Vital for Life.

Peter M. Gresshoff
Director, CILR.
March 2006

Special issue of *Functional Plant Biology*

July 2006



"Caves of life"

The journal *Functional Plant Biology* will be producing a special July edition dedicated to the Third International Conference on Legume Genomics and Genetics (ICLGG3). The issue will include contributions from the laboratories of Dr Noel Ellis, Dr Michael Udvardi, Associate Professor Steven Clark, Professor Randy Shoemaker, Professor Doug Cook, and Senior Editor of the journal *Science*, Pam Hines.

This picture (left) will grace the front cover of the July edition. It was taken by CILR Honours student Yu-Hsiang Lin as part of his Honours thesis "Development of a bioassay for the identification of the soybean shoot-derived inhibitor (SDI) signal in autoregulation of nodulation (AON)." Wild-type soybean was fed through a petiole with safranin O as an indicator of whether the feeding method was successful in translocating solution to the roots. The picture shows xylem vessels with surrounding support tissue stained red.

Functional Plant Biology may be found at
www.publish.csiro.au/journals/fpb

Back to the future for biofuels

"The use of vegetable oils for engine fuels may seem insignificant today, but such oils may become, in the course of time, as important as petroleum and the coal-tar products of the present time."

Rudolf Diesel, 1912

"I have come today to discuss unbelievable opportunities for our country to achieve a great national goal, and that is to end our addiction on oil."

President Bush at a panel on energy conservation and efficiency, February 2006

Soybeans provide a green alternative to fossil fuel

Photograph courtesy of the USDA

Time is running out. Nonrenewable carbon energy resources are diminishing. If we don't want to freeze in the dark we must prepare for the transition from nonrenewable fossil fuels to renewable bioresources advise Ragauskas and collaborators in the journal *Science* earlier this year (311: 484-489). A research road map incorporating an integrated biorefinery approach is essential to meet the world's changing energy needs.

Biofuels are not a new concept. Rudolph Diesel's first internal combustion engine was powered by peanut oil. During the 1920s, diesel engine manufacturers altered their engines to use the fossil fuel petroleum instead of vegetable oil because it was much cheaper to produce. Only recently have environmental impact concerns and a decreasing cost differential between fossil fuels and biomass fuels such as biodiesel, made biopower a growing alternative. The revival of biodiesel production began with farm co-operatives in Austria in the 1980s.

Biodiesel fuel is made from renewable materials such as vegetable oils and animal fats. It is non-toxic and biodegradable. It produces significantly fewer emissions when burned compared to petroleum-based diesel. Diesel blends containing up to 20% biodiesel (B20) can be used in most diesel-powered equipment, and higher-level blends and pure biodiesel (B100) can be used in many engines with minimal or no modification.

Plants convert solar energy into chemical energy using photosynthesis, and it is this chemical energy that biodiesel releases when burned. Soybean and canola are the primary source for biodiesel in the United States and Europe respectively. Biodiesel is commercially available in most oilseed-producing states in the United States. The Jatropha tree is used as a significant fuel source in India and south-east Asia. Local biodiesel production in India is being used to power three-wheeler motor rickshaws. Here in Australia, commercial biodiesel production is in its infancy. But notably, all of the public transport trains and most of the public transport buses in Adelaide have been operating on a B5 blend (5% biodiesel) since March 2005.

Biodiesel is undoubtedly a promising alternative to fossil fuels. But several issues need to be resolved. Currently, worldwide production of vegetable oil and animal fat is not sufficient to replace liquid fossil fuel use. More research is needed to find suitable crops and improve oil yield. With current yields, huge amounts of land and fresh water would be needed to produce enough oil to completely replace fossil fuel usage. Soybean is a major source of biodiesel in the United States because it is commonly grown. It is not a very efficient crop solely for the production of biodiesel. However, an important consideration in this issue relates to energy input versus energy output, in other words, efficiency. For example, the photosynthetic machinery that captures the solar energy to produce chemical, oil-based energy is made up of proteins and requires nitrogen input. Crops such as oil palm, corn and canola require fertilizer nitrogen input, which decreases the cost-benefit. In contrast, soybean as a legume provides its own nitrogen for protein synthesis, making the simple bean a wonderful resource to drive our vehicles cleanly and efficiently into the future.

Vein-derived cells, root meristems and the *Medicago truncatula SKL* mutant

Professor Barry Rolfe (left) and Associate Professor Ray Rose (right).

There's a research principle that for every question answered 10 more arise. This certainly was the case when Professor Barry Rolfe and Associate Professor Ray Rose were collaborating on the use of mutants to investigate root formation in cultured leaf explants of Medicago truncatula. One day Barry asked Ray if the roots had normal morphology, so Ray decided to check out some serial sections under the microscope. He noticed there was "something funny" about where the roots were coming from, although the roots themselves looked normal. Amazingly, Ray saw cells tracking out from the veins, and in some cases giving rise to clear meristems. A new stem cell concept was born. This exciting study has just been accepted by the Journal of Experimental Botany and has influenced CILR's stem cell thinking enormously.*

CILR introduces vein-derived cells to the plant world …

Leaf explants treated with auxin to form calli that produce roots is a classic auxin response. What has been given little attention is the progenitor cells from which these organs form. The leaf explant consists of epidermal, mesophyll and vascular cells that could contribute cells to the callus and have different developmental fates. Histological investigations revealed an unexpected order to the callus and the cells from which the root meristems form. Fig. 1. shows a longitudinal section through a leaf explant and the callus that has developed from it. What can be clearly visualised is a sheet of cells that can be traced back to cells of the vascular tissue consistent with having been derived by cell divisions from vascular tissue cells. These latter cells we have called vein-derived cells (VDCs) are rectangular-shaped and in the tissue they form there is little intercellular space. Adjacent to these cells are larger, more spherical cells, which are typical of callus-like cells and derived from mesophyll cells. These cells are much more loosely packed and are surrounded by large intercellular spaces.

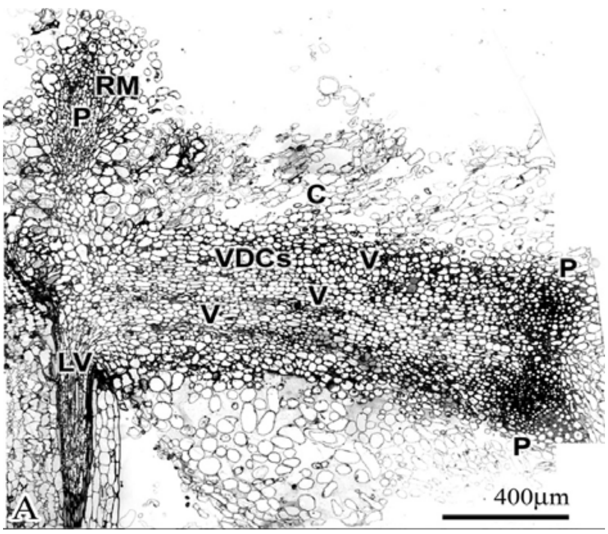


Fig. 1. Longitudinal section through a leaf explant and associated callus tissue 2HA.

Montage shows vein derived cells arising from a vein of a leaf explant and producing root primordia and vascular tissue cells.

C = Callus cells derived from mesophyll cells, L = Leaf explant, LV = Leaf vein, P = Root primordium, RM = Root meristem, V= Vascular tissue cells, VDCs = Vein derived cells.

The VDCs are the site of the developing root meristems (Fig. 1) and appear to be the progenitor cells of the meristems. These VDCs are also the source of the tracheids that differentiate from these cells. The VDCs are derived from the abaxial side of the leaf from cells more likely associated with the phloem tissue. This is because the phloem is located on the abaxial spongy mesophyll side of the leaf and the xylem on the adaxial side of the leaf. The root meristems that form from the VDCs develop into roots with normal morphology when viewed in longitudinal and transverse section.

What are the cells that produced the VDCs in this study? This question cannot at this stage be answered unequivocally other than that the VDCs appear to be derived from the cells of or near the phloem. The candidates are phloem parenchyma cells, the sheath cells surrounding the vein or procambium cells that would normally be recruited for vein formation in the growing leaf. Procambium usually moves ahead of vascular tissue and the phloem and xylem cells are derived from these cells. However, it is possible that there is a reservoir of procambium cells that remain in the primary vein.

There is support for the idea that veins are a rich source of stem cells. For example, wounding studies

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* "Root meristems in *Medicago truncatula* tissue culture arise from vascular-derived procambial-like cells in a process regulated by ethylene." Rose R., Wang X., Nolan K., Rolfe B. Jeremy Weinman is acknowledged for helpful input into the manuscript.

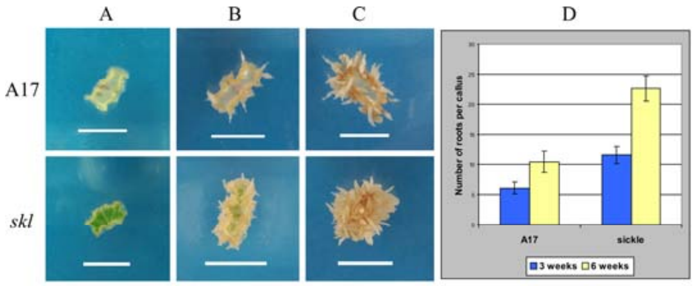


Fig. 2. Auxin-induced root formation in skl mutant and wild type (A17) leaf explants.

The explants were photographed at 12 days (A), 3 (B) and 6 (C) weeks. Root formation is stimulated in the skl mutant (D).

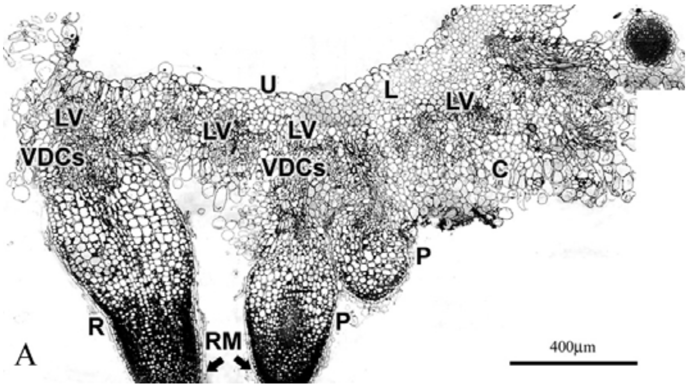


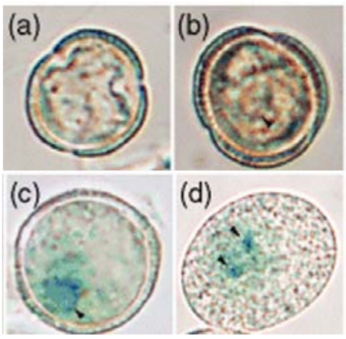
Fig.3. Transverse section through the root-producing leaf explant of the skl mutant.

CX = Calli cells derived from mesophyll cells, L = Leaf explant, LV = Leaf vein, P = Root primordia, R = Root, RM= Root meristem, U = Upper surface of leaf explant, VDCs = Vein derived cells.

show that severed veins can rejoin. What we suggest is that the procambium cells are pluripotent stem cells, which can be readily switched into the root differentiation pathway. What appears to be occurring in the case of *M. truncatula* leaves is the production of procambial-like cells that are pluripotent, producing both vascular tissue and root meristems. The initiation of lateral and adventitious roots has a close association with vascular tissue as do root nodules. In all these cases there is an auxin involvement in the regulation.

The development of root primordia from these pluripotent VDCs was clearly up regulated by the use of the *sickle* (*skl*) mutant, which is a mutant impaired in ethylene signal transduction (Fig.2). The enhanced auxin-stimulated root formation in the *skl* mutant suggests that blocking ethylene transduction in this mutant enhances root meristem initiation by enabling more stem cells to differentiate in this direction; rather than producing vascular tissue (Fig.3). Ethylene is known to inhibit the growth of roots and the early stages of lateral root and nodule formation, that is, it inhibits the progress of organogenesis of root outgrowths. In our situation the loss of ethylene sensitivity, in the *skl* mutant, enables a marked increase in successful root formation and little tracheid (vascular tissue cell) formation.

Survey of Arabidopsis histone genes yields a tissue-specific variant



Expression of AtMGH3:GUS during pollen development.
(a) uninucleate microspore (b) early bicellular pollen (c) late bicellular pollen (d) mature tricellular pollen.

Histones are the protein component of chromatin, the protein-DNA complex involved in DNA packaging and transcriptional regulation. The basic repeating unit of chromatin is the nucleosome, which consists of 146 bp of DNA wrapped around an octameric unit of the core histones H2A, H2B, H3, and H4. There is increasing interest in the mechanism of chromatin modification involving the incorporation of histone variants into nucleosomes. Histone variants are non-allelic isoforms of the conventional histones that show sequence variations. While histone variants have been well studied in animals, little is known about their role in plants.

A recent study led by Melbourne-based CILR Chief Investigator Associate Professor Prem Bhalla and published in *The Plant Journal* takes a detailed look at histone H3 genes in a model plant system for the first time. The research team searched the Arabidopsis Information Resource database and found 15 histone H3 genes in the Arabidopsis genome. Analysis of one of the genes named *AtMGH3* found it was only switched on in pollen sperm cells. Disabling the *AtMGH3* gene had no effect on plant development, probably because the other H3 genes compensated for its loss. Gene duplication of Arabidopsis H3 genes was evident, suggesting there is some redundancy in their activity.

Notably, the proteins made by the histone genes were found to be highly conserved from plants to fruit flies and humans. The researchers also found that the more complex the organism, the more H3 genes it has. Yeast has three H3 genes, the flatworm *C. elegans* has 23, and the mouse has 57.

Plant stem cells carve their own niche

The use of embryonic stem cells in therapeutic applications has dominated every media around the globe in recent years. But stem cells are old news for plant scientists. Professor Mohan Singh and Associate Professor Prem Bhalla review the common ground between plant and animal stem cells in Trends in Plant Sciences this month…

Plant stem cells made a quiet entrance more than 100 years ago. It was in 1902 that an Austrian botanist Gottlieb Haberlandt introduced the term "totipotency" to describe the ability of a cell to develop into another cell type. This concept was demonstrated in 1958 when a carrot plant was cloned from carrot cells that had been cultured *in vitro*.

Stem cells in plants and animals share many features. It would seem that a mutual need to maintain a reservoir of undifferentiated cells capable of self-renewal has driven this convergent evolution. Both have a remarkable ability to replenish themselves through self-renewal, as well as the potential to generate differentiated cells. Each new cell generated by the division of a stem cell can either stay as a stem cell or differentiate into a specialised cell.

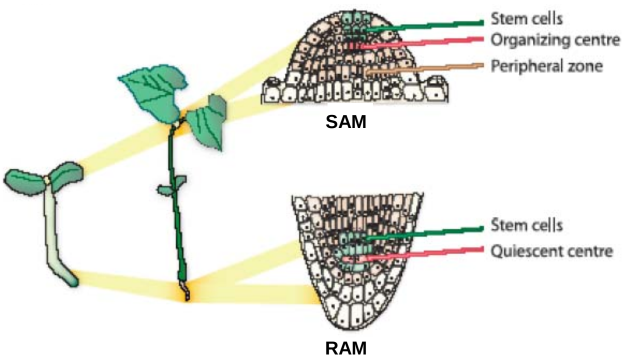


Illustration of plant shoot apical meristem (SAM) and root apical meristem (RAM) stem cell niches.

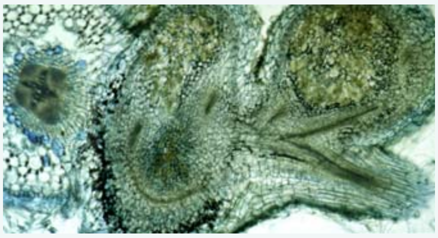
Animal and plant stem cells have a home or niche - a specific location in a tissue where stem cells reside for an indefinite period of time, producing progeny cells while self-renewing. Importantly, neighbouring cells release signals required for stem cell regulation. Plant stem cells are found within meristems, specialised structures present at root and shoot tips. Stem cells in the shoot apical meristem (SAM) provide the cells for continuous development of new organs such as stems, leaves, flowers, fruits and roots. Stem cells in the root apical meristem (RAM) provide the cells for the formation and continuous development of the root system.

The cells surrounding plant stem cell niches located in meristems provide signals to maintain the stem cells in an undifferentiated state. In Arabidopsis, stem cells are maintained by two-way signalling between stem cells and the "organising centre" which is a group of cells immediately beneath the stem cells. The RAM niche regulates the maintenance of root stem cells. The signal that maintains these stem cells originates from a small group of cells that reside in the quiescent centre at the centre of the root tip.

Any gap between plant and animal stem cells has recently become even smaller with the finding that the plant equivalent of a well-known tumour suppressor gene in humans is involved in RAM stem cell maintenance. The retinoblastoma-related (RBR) gene is involved in a pathway to regulate the size of the RAM stem cell population. In animals, the retinoblastoma (Rb) tumour suppressor gene prevents cell division by repressing the E2F/DP family of transcription factors that regulate the expression of genes involved in cell proliferation and survival.

A detailed understanding of the molecular mechanisms that underpin stem cells remain elusive. Are there any stem cell-specific genes that confer "stemness"? Is the absence of external signals sufficient to maintain stem cells in an uncommitted state, or is there any intrinsic regulation at the transcriptional and post-transcriptional levels? Several studies of different animal stem cells have not revealed a conserved stem cell molecular signature. This has led to the suggestion that "stemness" represents a state rather than a defined entity. Furthermore, it has been proposed that the combined effect of small quantitative differences in many different genes can account for variations in the establishment of a stem cell state. Clearly, cell-type-specific gene profiling represents a powerful tool for analysing gene networks of plant stem cells and the surrounding cells that support them. However, isolating sufficient pure cells from a complex tissue poses a major hurdle. Combining laser-assisted microdissection to isolate specific cell types with genome-wide transcriptional profiling will be the key to unravelling the molecular road map controlling plant stem cells and their niches.

Bacteria roll over in the clover



Cross section of a hybrid structure. The root outgrowth does not contain symbiotic bacteria and the development of the hybrid that results is abnormal. A lateral root is seen emerging from the hybrid.

Legumes rely on soil bacteria to provide them with useable nitrogen. This symbiosis with rhizobia underpins agriculture worldwide; efficient production of wheat in Australia for example is not possible without first growing legume pastures such as clover prior to growing wheat so that soil nitrogen content is replenished.

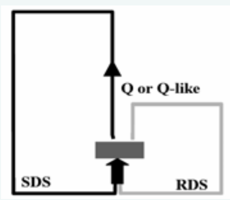
A new study led by ANU Chief Investigator Dr Michael Djordjevic and published in the journal *Molecular Plant-Microbe Interactions* last month reveals how the symbiotic process can sometimes "go off the rails". Using fluorescent tags that mark the bacteria and microscopy, the study found that certain clover bacteria known as ANU794 failed to establish normal infections in the roots of a particular variety of clover called Woogenellup.

The bacteria with stalled infections induced two other organ types: never seen before abnormal growths called "hybrids", and lateral roots. Unfortunately, symbiosis fails to establish and the plant does not benefit from the association. ANU794 is still used by agricultural companies to inoculate other clover pastures to enhance soil fertility, but the failed symbiosis is a reason why Woogenellup has been replaced by other varieties.

The team is not sure what causes the malfunction. It is possible that abnormal infection with poor root nodule development represents an intermediate step in nodule evolution, where the bacteria make the right signal but the fine tuning of symbiosis is not optimal. Another possibility is that the bacteria make two competing signals: one triggering nodule formation and the other lateral roots, and the plant becomes "developmentally confused".

Root nodule formation is a relatively young process: the oldest fossilised legume nodules date back 60 million years. Plant and bacterial cells have learnt to co-exist in a fine-tuned intimate association over millions of years of evolution. Normally, plant infection by bacteria would result in disease.

Root development minus rhizobia - the root and shoot of it



Root growth under non-symbiotic root development. There are two loops. One functions in the root to stimulate growth (RDS). The other is a root-shoot-root circuit also stimulating root growth (SDS).

RDS - root-derived stimulator.
SDS - shoot-derived stimulator.
Q - unknown root-derived mobile signal.

A UQ study just accepted in the *Journal of Plant Physiology* has concluded that altered root growth of a Lotus hypernodulation mutant grown in the non-symbiotic condition is controlled by both the shoot and the root. There is developmental co-regulation of nodulation and root growth.

The finding has agricultural significance in that it provides insights into how plants form deep and branched roots. This in turn affects how plants acquire water and escape from toxic top soils.

A model for Autoregulation of Nodulation (AON) was first described in 1986 by Gresshoff and Delves, and postulates that a signal produced by the roots stimulates the production/release of a shoot-derived inhibitor of symbiotic development at the continued cell division stage.

In the current study, Buzas and Gresshoff used grafting techniques to investigate the control of the non-symbiotic retarded root growth phenotype of *Lotus japonicus* har1-1 (hypernodulation and aberrant root) mutant.

They found a pre-existing regulatory network involving both the root and the shoot. When inoculated with rhizobia, the "shoot loop" predominated and regulated nodulation and root growth. However, when uninoculated, both the root and shoot contributed equally to root growth.

The current research expands on a 2002 *Nature* paper (420: 422-426, 2002) by Krusell and colleagues that claimed that nodule and root development was controlled solely by the shoot. Clearly the present study is getting to the root of the problem.

CILR teacher professional development steps out

CILR Research Fellow Dr Flavia Pellerone (far right) workshops nodulation with teachers at the Australian Science Teachers' Association annual conference (CONASTA).

The UQ node of CILR is running a week-long teacher professional development program for 10 teachers from July 24-28, 2006. The program has been developed in collaboration with Education Queensland as part of the Queensland Government's Spotlight on Science initiative.

STEP IN LABS! (Science Teachers Education Partnership IN Legumes And Biotechnology Studies) aims to show teachers the latest advances in plant science through a series of lectures and hands-on laboratory work. Following orientation, teachers will spend two days with the Centre's Research Fellows, learning more about their individual projects. Teachers will also be shown several experiments they can take back to the classroom. These will include workshops on nodulation and nitrogen fixation, plant tissue culture and the role of gibberellins in controlling stem elongation.

More information on the STEP IN LABS! program can be found at http://www.cilr.uq.edu.au/

For applications go to http://education.qld.gov.au/curriculum/area/science/partners-legume.html

Applications close June 2 2006.

CILR gets into student workshops

Kelvin Grove State College students Sophie St Ledger, Kellie Christensen and Laura Dunstan (top) get into DNA while Amy Wakem (below) loads a gel.

CILR is planning workshops for primary and secondary schools later this year, so we were very pleased to facilitate a series of workshops run by the Australian Centre for Plant Functional Genomics (ACPFG) and the Molecular Plant Breeding CRC (MPBCRC) in March. Bruce Stevens from Education Queensland helped identify suitable schools.

Belinda Barr (Communications and Education Manager, ACPFG) and Dr Amanda Able (Education Manager, MPBCRC) presented their "Get into Genes" workshop to three Brisbane-based schools: Kelvin Grove State College, Wellington Point State High School and Browns Plains Secondary School.

Get into Genes is a two-hour interactive biotechnology education program that shows how DNA technology is used in molecular plant breeding programs. Students experience hands-on work stations that teach them about conventional plant breeding, DNA extraction, gel electrophoresis, restriction enzymes and molecular markers.

The program was well received by more than 100 students over three days.

"It was particularly interesting to understand how DNA can be used to identify characteristics of an organism and how these can lead to improvements in crops."

Jordan Reutas, Year 12, Kelvin Grove State College

"My favourite part was using the electrophoresis tank. Here we used a 20 micro litre pipette to fill the wells in the electrophoresis gel. It was a great challenge to get it accurate. It was a good experience and sparked my interest in Biotechnology."

Amy Mullaly, Year 9, Kelvin Grove State College

Community work makes fair exchange

Henry Cook, Billy Bunter, Miles Holmes, Teddy Morrison (left to right).

CILR aims to develop a broader understanding of legumes through its Natural Science - Social Science Linkage Program. The program encompasses GM issues, and Aboriginal knowledge and use of legumes.

Social anthropologist and CILR PhD scholar Miles Holmes is investigating the cultural and economic significance of several Acacia and Erythrina species to Warlpiri Aboriginal people living in the remote Northern Territory community of Lajamanu.

The picture (left) shows Miles with some of the senior men in Lajamanu. They are holding a kurdiji which is a Warlpiri word for a shield made from yinirnti, the soft timber of the leguminous tree *Erythrina vespertilio* (Bean Tree). Shields of this type are used for fighting or for making fire with the friction method. In a ceremonial context they can be ritual objects and are also regularly exchanged amongst the Warlpiri and with neighbouring groups. The photo shows an exchange of sorts with a painted shield being presented to Miles as a gift for work in the community.

The Bean Tree's soft timber is ideal for making shields and bowls. Its bark has medicinal uses, the roots are edible and seeds are used to make decorations. The Bean Tree features prominently in rituals, songs and ceremonies. An investigation of Warlpiri understandings about this iconic desert legume is just one aspect of Miles' PhD research.

Soybeans reduce prostate cancer risk

A Swedish population-based study has found a high intake of food rich in phytoestrogens is associated with a decreased risk of prostate cancer.

The mighty soybean cuts prostate cancer risk

The research published in *Cancer Causes and Control* in February questioned 1499 men diagnosed with prostate cancer about their eating habits and compared them to 1130 healthy men.

Men who ate a lot of flaxseed, sunflower seeds, berries, peanuts, beans and soy were less likely to develop prostate cancer.

Phytoestrogens are naturally occurring hormone-like compounds found in plant food. They can be subdivided into several subgroups; coumestans, isoflavanoids and lignans.

Notably, the research team found no link between dietary intake of total or individual lignans or isoflavanoids and risk of prostate cancer.

Coming up in 2006 . . .

April

9 - 13 Third International Conference on Legume Genomics (ICLGG-3)
Brisbane, Queensland

July

17 - 21 Experience Science Program
UQ BACS Faculty student workshops
(UQ node of CILR is taking part)

24 - 28 STEP IN LABS!
CILR teacher professional development program
UQ node of CILR

August

20 - 25 8th International Congress of Plant Molecular Biology
Adelaide, South Australia

September

24 - 28 ComBio
Brisbane, Queensland

Also ahead. . .

CILR Workshop
Protein expression in heterologous systems
University of Melbourne, Victoria

Pod people

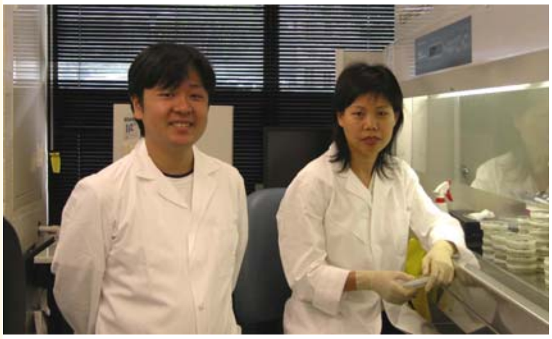
Education is an important part of CILR's mission - meet two people visiting CILR to learn more...

Cuc Nguyen, Occupational trainee

Cuc grew up and went to school in Vietnam. She moved to Holland for her tertiary education after her father saw a newspaper advertisement looking for prospective students to study at Han University in Nijmegen. Cuc attended an interview and won a place to study for a BSc degree (life sciences).

As part of her fourth year studies she is required to complete a research project and thesis. Her supervisor recommended CILR as a destination and the rest as they say is history. Cuc is here for eight months studying "The role of lipid transfer protein in autoregulation of nodulation." She sends monthly reports back to her supervisors in Holland.

This is Cuc's first trip to Australia, and she loves the Brisbane lifestyle and climate.



Susumu (left) with CILR's plant tissue culture guru Snow-Li (right).

Dr Susumu Hiraga, Group leader

National Institute of Crop Science, Tsukuba, Japan

Dr Susumu Hiraga met CILR Director Professor Peter Gresshoff at the SABRAO Conference in Japan last August. He visited the UQ node of CILR for two weeks in February to learn about Agrobacterium-mediated soybean transformation and to build collaborations with UQ researchers. The National Institute of Crop Science provided financial support for Susumu's trip.

Susumu learned some useful techniques from CILR's expert plant tissue culture technician Snow-Li (pictured right). "It was good to exchange opinions on soybean transformation," he says. However, Susumu will do things a little differently on his next trip. "I really enjoyed my short stay in Australia. Next time, I would like to stay for a longer period."

The new CILR website goes live at the end of April ...

A new look for our old website at the same address

www.cilr.uq.edu.au