



*Benefiting
industry
through
improved
tools for
plant
breeding.*

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**Cooperative
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International molecular plant breeding master class

As part of a plan to pass on technologies to both Australian industry and developing nations, a molecular plant breeding master class was conducted at the end of last year involving CRCMPB staff from Adelaide University, Southern Cross University and the Agriculture Victoria Plant Biotechnology Centre.



In the field: Andy Barr speaks to a group at a property near Bordertown, SA

The three week class involved 17 participants from Australia, China, Iran, Indonesia, Mongolia, Syria, Thailand, Turkey, Vietnam and the Sultanate of Oman who were shown the latest techniques in the field.

Master class convenor Professor Peter Langridge said the master class had been an exciting opportunity to share new techniques in molecular plant breeding and gave the participants skills which could be implemented and of assistance to their relevant industries at home.

"The class focused on molecular techniques that promise to greatly increase the speed and sophistication of plant breeding so we can improve production, build in resistance to pests and diseases, enhance traits like micronutrients, and protect the environment," he said.

The group spent two weeks at the CRC MPB's central office at the Waite Campus in Adelaide, before spending their final week at the Plant Biotechnology Centre at LaTrobe University in Melbourne. Funds were provided by the Crawford Fund, GRDC, ACIAR and the CRCMPB.

From the Director

Restructure to focus on outcomes

The programs of the CRC MPB have been restructured to highlight the importance of working strategically towards outcomes.

The CRC MPB was established to achieve results in molecular plant breeding through synergies and partnerships. We are currently at the half way mark of our seven-year term so it is critical we are clear on the outcomes we aim to achieve and ensure the resources required to achieve them are provided. We also need to be able to demonstrate significant progress towards achieving tangible outcomes and products by our five-year review in 2002.

The restructure will ensure the programs are focused on producing outcomes in the next three and a half years. Plans for the restructure were developed by the Program Management Committee following the planning retreat held late last year, and the proposed changes were recently approved by the Board.

The overall outcomes of the CRC research program are associated with molecular markers and novel genes for cereal and pasture grass breeding, so these principles guided the formation of the new programs as follows:

CEREALS

Molecular Markers (CM)

Genetics, identifying and mapping of markers (CM1)
Using markers (CM2)
Strategies for molecular breeding (CM3)

continued on next page..

Novel genes (CG)

Exploiting novel genes and technologies

PASTURES**Molecular Markers (PM)**

Genetics, identifying, mapping and using markers

Novel genes (PG)

Exploiting novel genes and technologies

EDUCATION

Education and training in molecular plant breeding

MANAGEMENT

Management of the CRCMPB

The intended outcomes for the marker programs in cereal and pasture grass breeding include genetic understanding, markers for disease resistance, quality and abiotic stresses, pathogen identifications and quantification, germplasm and software for breeders.

Increased knowledge, novel genes, promoters and transgenic cereals and pasture grasses are the outcomes the novel gene projects for pasture grass and cereal breeding are working towards.

The new structure is designed to provide a continuous flow from basic research to implementation, rather than separating these aspects. It also aims to improve interactions between the cereal and pasture research programs and to actively involve breeders in CRC implementation programs.

The Program Management Committee is currently reviewing all projects to ensure the outcomes are consistent with overall target outcomes of the CRC, assess the progress towards achieving these outcomes, and identify changes in the research or resources required. New initiatives will also be developed to ensure the outcomes of the CRC are achieved.

I believe the new structure gives a clear approach for the future and ensures we will achieve the results our participants intended. Further program details can be found at www.molecularplantbreeding.com and we will be introducing and profiling the research programs and leaders in future editions of 'on the mark'.

Bryan Whan

Researcher wins top honour

CRC for Molecular Plant Breeding Program Leader Professor German Spangenberg and his Pasture Genomics and Gene Technology team recently received the prestigious Daniel McAlpine Outstanding Achievement Award.



Professor Spangenberg, who is also Director of the Plant Biotechnology Centre at Agriculture Victoria, Department of Natural Resources and Environment, received a \$5,000 travel scholarship with up to six months paid leave of absence and a uniquely sculptured trophy.

The Daniel McAlpine Outstanding Achievement Award is presented annually to a scientist or team of scientists from the Victorian Department of Natural Resources and Environment (DNRE) in recognition of outstanding agricultural or environmental research and/or extension work completed in the past three years.

Professor Spangenberg and his Pasture Genomics and Gene Technology team were commended for their research into pasture plant genomics. Professor Spangenberg was presented with the award from the Year 2000 Australian of the Year, Sir Gustav Nossal, at the new Melbourne Museum in mid-December last year.

Daniel McAlpine was a plant pathologist in the Victorian Department of Agriculture in the early days of its establishment and Professor Spangenberg said it was an honour to receive the award named after "one of the founding fathers of plant pathology in Australia".

Professor Spangenberg is highly regarded as an authority on the genetic manipulation of pasture grasses, legumes and pasture plant genomics.

He and his team have developed the enabling technologies for the genetic manipulation of the key pasture grasses and legumes for temperate grassland agriculture worldwide. He has established one of the largest plant gene discovery programs in Australia, using state of the art technologies for accessing the genomes of ryegrass and clover, and building on an outstanding expertise in the development and application of gene technology and functional genomic tools for pasture species.

Products and molecular technologies developed by the team are already being implemented in Australia's national breeding programs for clover and ryegrass. They primarily target increased production through eliminating huge annual losses from biotic and abiotic stresses in pastures. These improvements will be of considerable benefit for the development of a sustainable pasture-based agricultural industry in the new millennium.

Trip to San Diego and CIMMYT for researchers



CIMMYT headquarters in Mexico

Researchers from the CRC MPB were joined by almost 2000 people from around the world attending the Plant and Animal Genome Conference in San Diego in mid-January.

Professor Peter Langridge, Dr Kevin Williams and Angelo Karakousis attended the 5-day conference, learning more about plant genomes, attending workshops and seeing the latest in new technologies for plant breeding.

Angelo, who presented a poster on mapping the barley genome, said the conference was a great opportunity for CRCMPB researchers to make new contacts from international research organisations and to see the latest technologies on offer.

"There were some great displays on new innovative products involving robotics and DNA extraction machines as well as demonstrations on the latest in mapping software which may be of interest to the CRCMPB in the future," Angelo said.

After the conference Angelo and Kevin visited CIMMYT and spent two weeks working with researchers involved with wheat biotechnology and breeding. It was the first time Angelo had been to CIMMYT and he said it was a great opportunity to meet people with similar research interests.

"It was a great experience to see first hand their research programs, maps and markers and while I was there I presented a detailed workshop on genetic mapping software so it was a useful two weeks of exchanging ideas, findings and methodologies," Angelo said.

CIMMYT: in focus

The PhD program is a vital component of the CRCMPB. In this edition of the newsletter we introduce Magy Salgado and Juan-Jose Olivares Villegas, CRCMPB PhD students based at CIMMYT in Mexico. Both students will be in Australia later this year to study and attend the CRCMPB Annual Research Meeting.

Magy Salgado

Magy Salgado comes to the CRCMPB with an impressive list of university qualifications and work placements in the field of plant biotechnology including a Bachelor of Biotechnology from the National Autonomous University of Mexico and Masters in Fruit Sciences from the Colegio de Postgraduados in Mexico. Most recently she has worked at the Applied Biotechnology Centre, CIMMYT.



For the next four years she will be working on her PhD project titled 'Characterisation of the effect of family 5 pathogenesis-related proteins (PR-5) genes in transgenic wheat (*Triticum aestivum*)'. She is primarily based at CIMMYT, Mexico, and is supervised by Drs. David Hoisington, Allesandro Pellegrineschi, and Professors Peter Langridge and Geoff Fincher.

Magy said the PhD program was a wonderful opportunity professionally and the links created for CIMMYT in the CRCMPB gave her access to first-class facilities and expertise from around the world.

"The big advantage of having links with both Mexican and Australian research organisations is that cooperation is leading to faster developments in improving wheat and other crops," Magy said.

She said the main objective of her research is to characterise transgenic wheat plants transformed with thaumatin-like (TLPs) genes that code for proteins related to pathogenesis (family 5) and to study the role of these genes in the control of a broad range of phytopathogenic fungi such as rusts, fusarium head scab, spot blotch, tan spot and *Alternaria* leaf blight.

The expression of TLP genes in transgenic lines may offer a reliable, effective, stable and durable control of important fungal wheat diseases in a relatively short timeframe. Insertion of antifungal transgenes into wheat, combined with host plant resistance genes, will provide plant breeders additional sources of resistance for enhancing cultivars with broad and durable field resistance.

Magy is keen to continue working in plant research and would like to work with the identification of interesting genes from antagonistic micro-organisms found in Mexican suppressive soils and to transfer these genes in plants in order to incorporate resistance against important phytopathogens.



Juan-Jose Olivares Villegas

Juan-Jose Olivares Villegas was drawn to the CRCMPB program because of the opportunity to gain a PhD with links to several international research organisations, exposure to top-level scientists and access to new technologies.

"The CRCMPB program also appealed to me because the research has a strong focus on practicability and real applications, linked to current and future agronomic problems," Juan-Jose said.

Juan-Jose started his PhD project, titled 'Development of molecular markers associated with genomic regions controlling components of drought and heat tolerance in bread wheats' in January last year and is supervised by Drs. David Hoisington, Manilal William, Matthew Reynolds, Glenn McDonald and Jean-Marcel Ribaut.

He gained his bachelor degree in Pharmaceutical and Biological Chemistry from La Salle University in Mexico City (1991-1996) before working in the Biotechnology Department at the National Research and Advanced Studies Centre in Mexico City.

Before starting his PhD studies, Juan-Jose worked as a research assistant at the Applied Biotechnology Centre, CIMMYT, where he was involved with the molecular analysis of transgenic maize and wheat plants.

Juan-Jose said the main objectives of his PhD research were the verification of physiological barriers involved in drought tolerance in wheat, identification of genomic regions associated with physiological traits using molecular markers, development of molecular markers linked to drought tolerance and a better understanding of the genetics of drought tolerance.

Drought is a major abiotic stress that considerably affects yield in bread wheat (*Triticum aestivum*). Many anatomical, physiological and biochemical traits are mentioned as being drought adaptive. A selection of them including chlorophyll content, leaf rolling and yield components are being studied to determine their degree of association with water stress tolerance.

Since drought is the result of the quantitative interaction of numerous genetic regions, one approach to dissect this complex trait is to utilise molecular markers on a given population to produce a molecular map which might help to analyse the quantitative trait loci (QTL) associations and interactions involved in drought tolerance. Ultimately, identification of linked markers and the elucidation of their relative positions in the genome, would shed light on the mechanisms that govern drought tolerance and, hopefully, allow the use of such markers in breeding programmes.

Juan-Jose will be in Australia between July and December this year and is looking forward to the opportunity to further his research project and experience the Australian lifestyle and culture.

Research to focus on phosphate transport



A CRC MPB research project focusing on phosphate (P) transport in plants could eventually lead to savings for farmers and improvements for the environment by determining which agricultural crops are most efficient at using the nutrient.

Donna Glassop, a CRCMPB PhD student, based at CSIRO Plant Industry, Queensland, said she was studying P

transport because it is one of the essential nutrients required by plants, playing a key role in all metabolic processes including energy transfer, photosynthesis and respiration.

With many Australian soils deficient in P, the use of fertilisers for profitable agricultural production is widespread. However, the ability of the plant to access this P is limited and results in millions of dollars annually being wasted through the inefficient use of fertilisers.

One way plants have overcome problems related to the absorption of P is to form a symbiotic relationship with mycorrhizal fungus. Known as mycorrhizal plants and accounting for 70 per cent of all plant species, the plant and the fungus exchange beneficial nutrients. Donna's project 'Phosphate transport in mycorrhizal plants' will focus on barley, which forms mycorrhizas in field conditions and is a very important crop.

"The main aim of my research is to discover more about the relationship between the fungus and the barley. We know that the fungus absorbs phosphorus in the soil and passes it on to the plant, but we are unsure about the point of exchange and the phosphate transporters involved," she said.

Donna said that although the fungus and the plant form a symbiosis, the two organisms are not actually connected; there is an interface between them. Adelaide University research suggests that the characteristics of this 'space', including distribution of P transporters on the cell membranes, play crucial roles in determining where and how the nutrient transfer occurs.

"I will be conducting experiments with the aim of conclusively showing where the P transfer occurs, which is important in terms of increasing our knowledge of mycorrhizal plants and how they exchange nutrients," she said.

Donna said that while scientists had been studying mycorrhizal plants for a long time, molecular methods and technological improvements have enabled them to look at plant roots and their symbionts in much finer detail, to gain a better understanding of various processes.

"Advances in technology mean our studies can progress much faster than before which will be of great benefit to all associated plant industries," she said.

Donna is using a process called in situ hybridisation which involves embedding barley roots in wax, cutting the wax into strips about 0.01mm thick, and introducing a DNA probe to indicate the presence of phosphate transporters. She will show which plant structures carry the transporters which are likely to be important sites for P transfer from the fungus.

She is also producing transgenic barley plants with a Green Fluorescence Protein (GFP) expressed by a barley phosphate transporter promoter. When the roots are put under a microscope they fluoresce if the enzyme has been expressed. Using this technique with mycorrhizal and non-mycorrhizal plants will allow her to establish in exactly which cells the phosphate transporters are active.

In Brief

CRCMPB Annual Meeting

The CRCMPB Annual Meeting will be held on 20-22 June 2001 at the Novotel Barossa Valley Resort. Information about the annual meeting will be sent to participants soon. The meeting provides an excellent opportunity for CRC participants to get together socially and to reflect on what has been achieved during the past year. The meeting will involve various sessions and workshops as well as social activities including wine tasting and tennis.

For more information contact Astrid Tiller on (08) 8303 7414 or email astrid.tiller@adelaide.edu.au

Plant breeding excellence award



Dr Yongguan Zhu from the CRCMPB and Adelaide University has recently been awarded the Jack Loneragan Award from the Plant Nutrition Trust of Australia.

Dr Zhu was the award's recipient on the basis of his past and present contributions to plant nutrition, recent contributions to plant breeding for nutrient efficiency, and his potential ability for future industry development.

He was awarded \$2000 which he will use to attend the XIV International Plant Nutrition Colloquium (IPNC) in Hannover, Germany, on 27 July – 3 August 2001. At the conference he will be presenting some recent results on phosphorus and zinc efficiencies of wheat DH lines. The conference will also give Dr Zhu the opportunity to discuss recent developments in plant nutrition with scientist from around the world.

Dr Zhu is currently working on a CRCMPB project titled 'Plant phosphorus efficiency: mechanisms and manipulation', at Adelaide University.

The aim of the project is to overcome current limitations in screening populations for traits related to phosphorus efficiency and to design assays that will focus on particular aspects of efficiency, particularly related to the involvement of mycorrhizal symbiosis in phosphorus uptake. This will enable the mapping of genes that are important in the efficient acquisition and utilisation of phosphorus by plants. This information will be used in breeding programs to produce cultivars that are able to make the best and most sustainable use of phosphorus either in the soil or applied to the soil.

Interesting Websites

WORK:

GrainGenes <http://wheat.pw.usda.gov/>

Known to many of you already, this site contains a small grains and sugarcane database, which is run by the United States Department of Agriculture. The website has information of both a technical and news-related nature. Currently the CIMMYT website is noted as a "Featured link"!

PLAY:

Sodaplay www.sodaplay.com

It's like meccano for the 21st century. A peculiar site which could potentially absorb you with its ability to build and animate shapes and critters simply. A very good alternative to solitaire on the computer! If you have the time that is!