International Centre for Plant Breeding Education and Research (ICPBER)

Kadambot Siddique, Wallace Cowling and William Erskine
Outline of the presentation

• UWA’s Agriculture and ICPBER
• Plant Breeding and world food production
• Challenges for future Plant Breeders
• ICBPER national and international support
• ICPBER goals, structure and funding
• ICPBER activities
Program 1: Integrated Land & Water Management
  Leader: Professor Zed Rengel
  Deputy Leader: Dr Daniel Murphy

Program 2: Animal Production Systems
  Leader: Professor Graeme Martin
  Deputy Leader: Dr Phil Vercoe

Program 3: Plant Production Systems
  Leader: Professor Stephen Powles
  Deputy Leader: Dr Guijun Yan

Program 4: Rural Economy, Policy and Development
  Leader: Professor Matthew Tonts
  Deputy Leader: Associate Professor Michael Burton

Program 5: Education, Outreach and Technology Exchange
  Leaders: Professor Kadambot Siddique
  and Mrs Christine Richardson
Education, Outreach and Technology Exchange

- To attract and train outstanding undergraduate and post-graduate students in a range of scientific disciplines leading to careers in agriculture and resource management;

- To provide professional training to people already in the workforce to augment their skills to better serve the agricultural and resource management industries;

- To facilitate opportunities for technology exchange & knowledge transfer to industry & the rural community

- To communicate the role of UWA in education, training and technology exchange to farmer groups, agribusiness, collaborators (national and international), funding bodies and potential students, highlighting the benefits contact with UWA may bring; and

- To raise public awareness and understanding of the significance of agriculture and resource management to WA and national economy
Challenges for the Industry

- A shortage of talented undergraduate and postgraduate (especially Australian resident) students to undertake agricultural and resource management studies.

- A shortage of qualified and well trained agricultural researchers and extension specialists to serve the industry.

- The small size of the research community and its physical isolation from the major Australian and international research groups which makes it difficult to attract talented researchers and significant new funding to WA, and may slow the transfer and adoption of new technology.
UWA’s Agriculture ranks 37 in the world and number 1 in Australia
International students in FNAS, The University of Western Australia

<table>
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<tr>
<th>Level</th>
<th>Re-enrolling</th>
<th>2008 (Jan-Jun)</th>
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<tbody>
<tr>
<td>Postgraduate students</td>
<td>49</td>
<td>14</td>
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<tr>
<td>Undergraduate students</td>
<td>64</td>
<td>44</td>
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</table>
The silent tsunami
The food crisis and how to solve it
The human surge

World Population: 1950-2050

Source: U.S. Census Bureau, International Data Base, August 2006 version.
Availability of arable land

Area of Arable Land (ha per capita)

Australia
Thailand
India
Pakistan
China
Indonesia
Malaysia
Vietnam
Phillipines
Bangladesh
Sri Lanka
South Korea
Japan
Climate Change:
Some areas are projected to become drier and hotter

Effects of global warming:

✓ Crops and livestock will face increased heat stress

✓ Developing countries in the south are likely to be negatively affected

✓ 11% decrease in cultivable rainfed land area projected by 2080 in developing countries

✓ The severest impact is expected to be in the Near East, North and Sub-Saharan Africa

Annual Mean Precipitation Change: 2071 to 2100 Relative to 1990
Economic Growth
Where the Economic Growth Will Be...2012

Note the fastest growing area is in Asia!

Source: W. Kirk Miller, Foreign Agricultural Service, US Dept. of Agriculture
The demand gap

Source: Goldman Sachs 2007
World grain stocks
Australian food and beverage exports by destination – sharing experience

- **Pacific**
  - meat
  - dairy
  - grains & flour
  - fruit & vegetables
  - seafood
  - wine
  - other food & beverages

- **Europe**
  - meat
  - dairy
  - grains & flour
  - fruit & vegetables
  - seafood
  - wine
  - other food & beverages

- **Americas**
  - meat
  - dairy
  - grains & flour
  - fruit & vegetables
  - seafood
  - wine
  - other food & beverages

- **Asia**
  - 2 US$b
  - 4 US$b
  - 6 US$b
  - 8 US$b
Knowledge drought

Figure 1  Public agricultural R&D spending trends

- Average annual growth (percent per year)
  - 1976–81
  - 1981–91
  - 1991–2000

- Regions:
  - Asia-Pacific
  - Latin America and the Caribbean
  - Sub-Saharan Africa
  - Developing countries
  - High-income countries
World’s major crop yields are falling behind
Three Pillars of Sustainable Agriculture

- Natural Resource Management
- Crop/animal Genetic Improvement
- Institutions, Policy, and Community Approach

Integration in Field
International Demand

An international platform and partnership of public, private and civil society institutions from the South and the North working in concert to promote Plant Breeding capacity building for crop improvement and sustainable development (FAO-based)
Global assessment of national PB capacity

Survey Status: 62 countries completed & 27 in progress
ICPBER Motto

*Professional Plant Breeders for Tomorrow*
1. Wild Relatives
Wild relatives of crops share common ancestors with crops but have remained in the wild as products of nature.

2. Land-races & Primitive Cultivars
Local crop varieties developed in primitive agricultural systems. Rather than being deliberately bred, farmers selected them over many generations.

3. Obsolete Cultivars
Obsolete cultivars, left over from the early days of plant breeding, are now mainly found in germplasm collections.

4. Advanced Breeding Lines, Mutations & Other Products of Plant Breeding Programs
Advanced breeding lines and stocks are plams which have been developed by breeders for use in modern scientific plant breeding. They include cultivars not yet ready for release to farmers.

5. Modern Cultivars
The high-yielding elite cultivars have been developed by scientific plant breeding for modern intensive agriculture.
Challenges for future plant breeders

• Understands the complexity of Genotype (G), Environment (E), Management (M) and Genotype x Environment x Management (G x E x M) interaction

• Locates new sources of genetic variation to correct weaknesses in cultivars and understands methods to introgress such variation efficiently

• Understands the importance of genetic variability for future crop improvement and has the skills to implement breeding principles efficiently

• Integrates the relevant disciplines to create a new product faster that is superior for target traits, stable in performance across locations, and acceptable to growers and consumers
Additional skills required for a Plant Breeder

- Molecular genetics and bioinformatics
- Population and quantitative genetics
- Genetic resources
- Plant pathology and Entomology
- Crop physiology
- Experimental design and analysis
- Remote sensing and spatial analysis
- Soil and environmental sciences
- Legal knowledge
- Business acumen, and People skills
ICPBER Goal

To establish UWA as the leading education and research Centre in genetics and plant breeding in Australia and the Asia-Pacific region and the Indian Ocean Rim, contributing to national and international efforts to enhance world food security
ICPBER Objectives

• To educate tomorrow’s plant breeders for Australia and New Zealand, Asia, the Pacific and the Indian Ocean Rim based on the core principles of genetics and supporting disciplines at undergraduate and postgraduate levels and also through in-service training.

• To be recognised as the preferred centre for international plant breeding education and research in Australia and by its near Asian and Indian Ocean Rim neighbours.

• To promote international and national collaboration in plant breeding through the exchange of students and researchers.
Value-addition from ICPBER

• Focus for PB teaching & research across Schools/Centres within UWA
• Establishing unique linkages with FAO-GIPB, the CGIAR research centres and national research organisations in Asia
• Heightening of the University’s profile internationally
• Establishing UWA leadership in Australian training in genetics and plant breeding
Training in Plant Breeding at UWA

Degrees in Genetics and Breeding
  – Co-taught with Animal Science
• Bachelor of Science – 4 years
• Graduate Diploma – First Year
• Masters of Science – Second Year
  – Coursework and Dissertation
  – Thesis and Coursework
• PhD
• In-service: Workshops & Short courses
Strong National Collaboration

- Australian Universities (Meeting at UWA in Sept 2008)
- Research institutions such as CSIRO and DAFWA
- Private breeding & seed companies incl. International and WA companies such as CBWA & InterGrain
- Industry: GRDC, RIRDC, HAL, COGGO, CBH and others
Strong International Collaboration

• GIPB-FAO
• IARCs - Joint PhDs
  – AVRDC
  – IRRI
  – ICARDA
  – ICRISAT
• UoGuelph & UC Davis (Exchange of lecturers)
• AusAID & ACIAR
International support – Univ Guelph

University of Guelph soybean breeder Prof Istvan Rajcan visited UWA (March 2007) – discussed proposal for Centre

• January 2008:

Wallace Cowling visited Univ Guelph (Falk and Rajcan) to promote exchange in plant breeding education and research.
July 9, 2007

Professor Alistair Robertson, Dean
Faculty of Natural and Agricultural Sciences M084
The University of Western Australia
35 Stirling Highway
Crawley
WA 6009
AUSTRALIA

Dear Professor Robertson:

I am writing on behalf of the instructors and staff of Plant Breeding Academy at the University of California, Davis. The Plant Breeding Academy is a professional development course that provides instruction in theory and application of the principles of plant breeding to students who are also professional plant breeders that are seeking more advanced knowledge of the science of plant breeding. Students in the Plant Breeding Academy make a two-year study commitment. That commitment includes six classroom sessions of approximately 60 hours each (September, February, and June) and reading and computational assignments during the intervening periods. More details of the UC Davis Plant Breeding Academy can be found at http://www.pba.ucdavis.edu.

The UC Davis Plant Breeding Academy is taught by internationally recognized plant breeders. Primary instructors in our course are UC Davis Professor of Plant Breeding and Agronomy, Larry R. Teuber; UC Davis Professor of Pomology, Doug Shaw; and Professor of Horticulture at North Carolina State University Todd Welmers. Dr. Teuber is an alfalfa ( lucerne) breeder, Director of the UC Foundation Seed Program, and Executive Director of the California Crop Improvement Association. Dr. Shaw is a strawberry breeder and has produced many internationally successful cultivars. He also has professional experience in sugar beet and forest tree breeding. Dr. Welmers is the breeder of cucumbers, watermelons, and other melons; he is also Assistant Head of the Department of Horticulture at NC State, and Secretary of the Plant Breeding Coordinating Committee.

At a time when private plant breeding companies have made major commitments to plant improvement and have become more active in plant breeding the number of training programs and trained graduate students has seriously declined. The UC Davis Plant Breeding Academy was formed as a recognition by both the University and private industry of the reductions in academic programs training plant breeders in the USA. This recognition has stimulated not only our Plant Breeding Academy at UC Davis, but also the recent national workshop on “Plant Breeding: A vital capacity for US National goals” held at NC State University Raleigh, North Carolina, in February 2007.
International support – FAO

• 1 February 2008: Dr Eric Kueneman, FAO, encourages UWA linkages into the Global Partnership Initiative for Plant Breeding Capacity Building (GIPB)
14 February 2008

PROFESSOR KADAMBIOT SIDDIQUE, FTSE
Chair in Agriculture and Director
Institute of Agriculture
The University of Western Australia, MO82
35 Stirling Highway
Crawley, Western Australia 6009
Australia

Dear Professor Siddique,

I am writing on behalf of the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT). We wish to inform you that we strongly support the initiative for "Capacity Building for Future Plant Breeding" at the University of Western Australia. We share your concerns about the present diminution of plant breeding education and training throughout the world. We therefore stand ready to collaborate in higher degree programs for students registered at the university by assisting with opportunities for them to experience real-life, real-time breeding programs with our mandate crops and through joint thesis supervision. I would also extend our willingness to collaborate in areas such as academic workshops and in sabbatical exchanges between our staff.

We look forward for a mutually beneficial collaboration and partnership with the University of Western Australia.

With best regards,

Yours sincerely,

William D Dar
Director General

Copy: Drs D Keatinge / B I Shapiro / C L L Gowda / V Balaji, ICRISAT
International support – IRRI

IRRI
International Rice Research Institute
Office of the Director General

Reference No.: DGO-1-2008-019

21 February 2008

Professor Syed Mustafa Siddique
Chair in Agriculture and Director
Institute of Agriculture
The University of Western Australia
Cr Steer, Western Australia 6009
Email: syed.siddique@westernuwa.edu.au

Subject: Proposal for a UWA International Centre for Plant Breeding Education and Research

Dear Dr. Siddique,

I am pleased to know about your proposal to establish at the UWA “International Centre for Plant Breeding Education and Research”. The centre’s mission to address the looming global skills shortage in plant breeding seems quite appropriate. I agree with you that the number of trained plant breeders has been falling and the deficiency in plant breeding education is being felt worldwide. Also, funding and support in Public Sector to plant breeding infrastructure and training has reduced considerably. Furthermore, there is a great need to integrate new advances in molecular genetics and genomics with the current plant breeding programs.

I appreciate the idea of in-service training for national and international plant breeders and research training for PhD and M.Sc students. The subjects (Quantitative Genetics, Molecular Genetics, Biometrics and IP Management) for training as outlined in the UWA proposal are quite relevant to IRRI’s on-going programs. IRRI has several degree (M.Sc. PhD) and non-degree (Post Doctoral Fellow) individual and group training programs in different disciplines in plant breeding, molecular marker assisted selection, and applied genomics. IRRI is involved in several collaborative research and training programs in many rice growing countries in Asia and Africa and with advanced research institutions/universities in USA, UK, Australia and Japan. IRRI will be willing to collaborate with UWA in degrees and non-degree (in-service) training programs and thesis supervision in different disciplines of Plant Breeding.

Sincerely yours,

[Signature]
Robert S. Zeigler
Director General

cc: Dr. D. S. Brain, Dr. Noel Magor

[Letterhead]
ICPBER Structure

- Centre will be in FNAS within the School of Plant Biology
- Director: Prof William Erskine
- Deputy-Director: A/Prof Wallace Cowling
- Project Officer: Ms Sarah Mawson
- Technical Advisory Committee (TAC)
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<td>Plant Biology</td>
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Proposed activities of ICPBER

- **August 2008**  Centre Launch
- Undergraduate and post-graduate promotional activities
- **September 2008**  Australian Plant breeding educators meet at UWA
- **November 2008**  Field trial design incorporating spatial analysis and information from relatives (Cullis et al, NSW Agric)
- **February 2009**  Population plant breeding (Falk, University of Guelph)
- **February 2010**  OECD conference on association mapping in Brassica
Acknowledgement

Alan Robson, Doug McEachern, Alistar Robertson, Hans Lambers, Lyn Abbott, Mike Perry, Christine Richardson, Renu Sharma and many others.

Plant breeding – somebody’s got to do it…