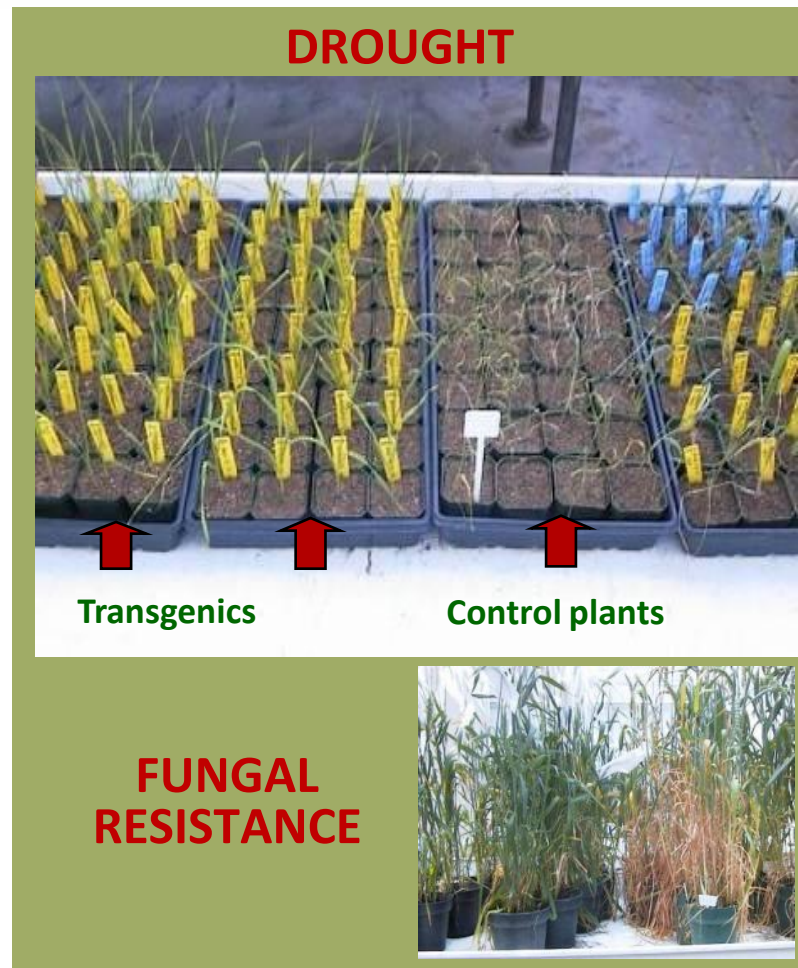




# and the Molecular Plant Breeding CRC?

- ❑ Key areas are **gene systems and transgenic technologies**
- ❑ Nodes in Universities and State Agriculture Departments (**headquartered here in Victoria**)
- ❑ Develops new generation breeding strategies, tools and molecular marker technologies
- ❑ Delivers tools, germplasm and cultivars to industry
- ❑ Applied transgenic approaches in **\$28million collaboration with BASF**
  - ❑ the first Australian proof of concept field trial of GM drought tolerant wheat in 2007, second trial in 2008, third trial underway
  - ❑ Preliminary results from these proof of concept field trials have been very promising
  - ❑ GM drought tolerant wheat 7 - 10 years away from market but the potential is real.





## ANU

- Arabidopsis as a model
- Molecular genetics and functional genomics of root mechanical stress
- Developed carbon isotope discrimination for water use efficiency

## Waite Campus-University of Adelaide

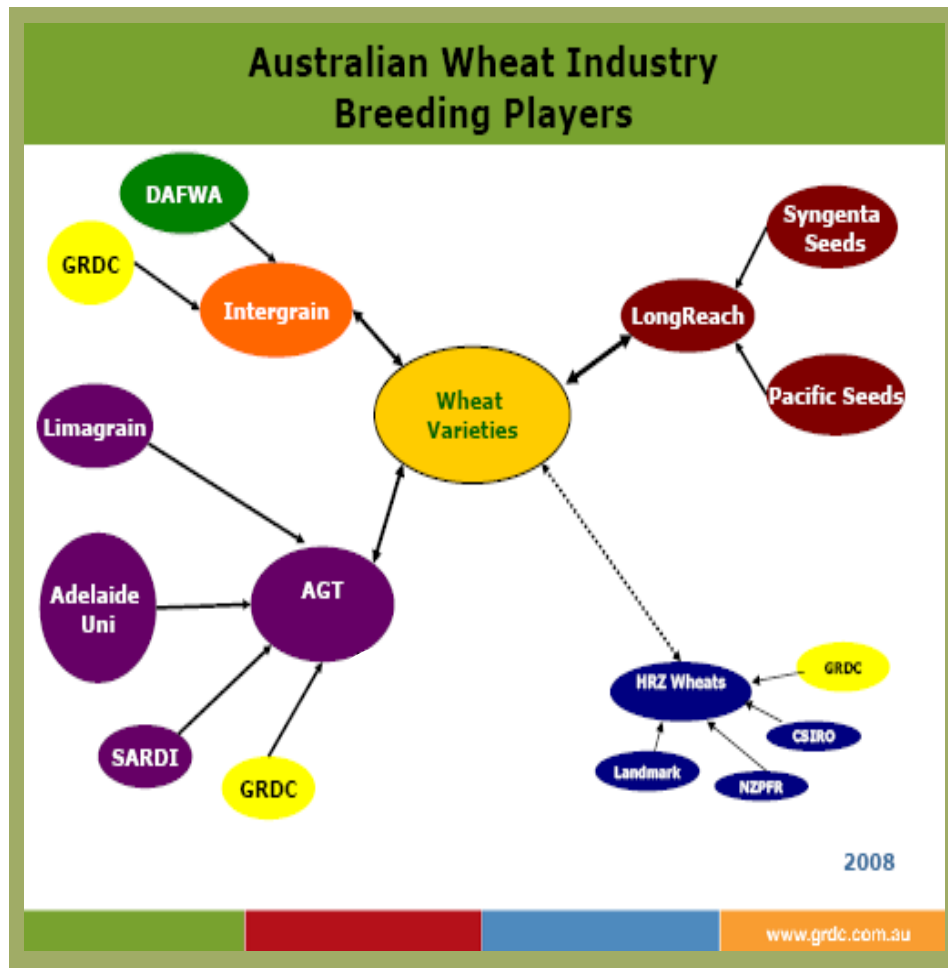
- Research income ~US\$100 million pa
- >1000 scientists, staff and postgraduate students at a centre covering 534 acres
- Genomics, cereal breeding, agronomy; home to **largest wheat and barley breeding programs**
- Well known worldwide
- + MANY MORE UNIVERSITIES



# who breeds wheat in Australia?

**AGT and Intergrain** are the largest wheat breeding companies

Largely owned by public sector except AGT is 32% owned by LimaGrain





# but, does it pay?

- Yitpi and Wyalkatchem are the most important two varieties on SA's Upper Eyre Peninsula (680,000ha)

## Gross Margin Calculations

### 2007

- Gladius \$73/ha > Yitpi and \$53/ha > Wyalkatchem
- \$42.8 million > income to UEP growers

### 2006

- Gladius \$34/ha > Yitpi
- Gladius \$23/ha > Wyalkatchem
- \$19.7 million > income to UEP growers

Costs are \$1.5 to \$2.0 million to develop a new variety

	1999-2003	2002	Change
RAC875	102	112	↑↑↑
Excalibur	102	110	↑↑
Krichauff	103	103	=
Yitpi	102	102	=
Janz	96	96	=
Kukri	96	97	=
Frame	100	96	
H45	102	96	

Yield in Drought Year (2002) vs  
5 Year Average

SARDI, SA Field Crop Evaluation Program



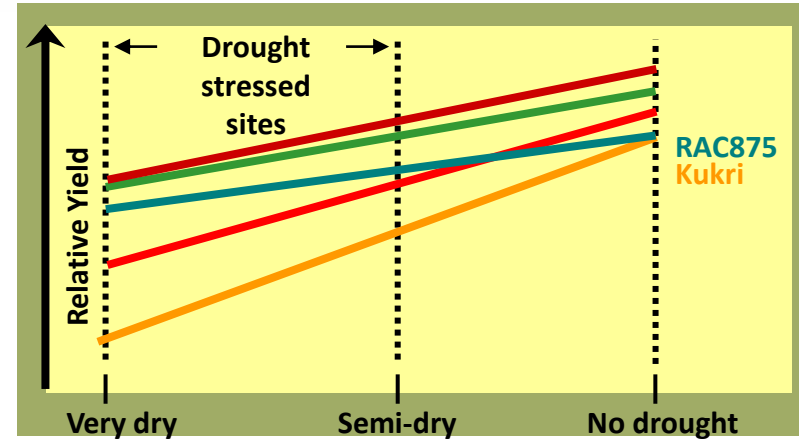
# ACPF; one of the larger groups

- **Gene Discovery**
  - Drought, salinity, frost
  - **Wheat and Barley**
- Forward and reverse genetic approaches
- Extensive use of new plant populations
- **140 Staff, 15m USD per year**
- Links with major international private and public research groups and companies
- Participating in developing world programs



## Field work (Collaboration with AGT)

1. Make new plant populations; use parents with interesting characteristics
2. Grow in field
3. Identify plants of interest (good and bad)
4. Genetic analysis to find out why (good and bad)
5. Information then feeds straight into breeding programs (non GM)
6. If genetic basis for differences, can isolate genes and make new plants (GM)



Number of field sites				
2006	2007		2008	
Australia	Mexico	Australia	Mexico	Australia
3	2	5	2	8

Mexico Irrigated



Mexico Drought



Roseworthy



Booleroo

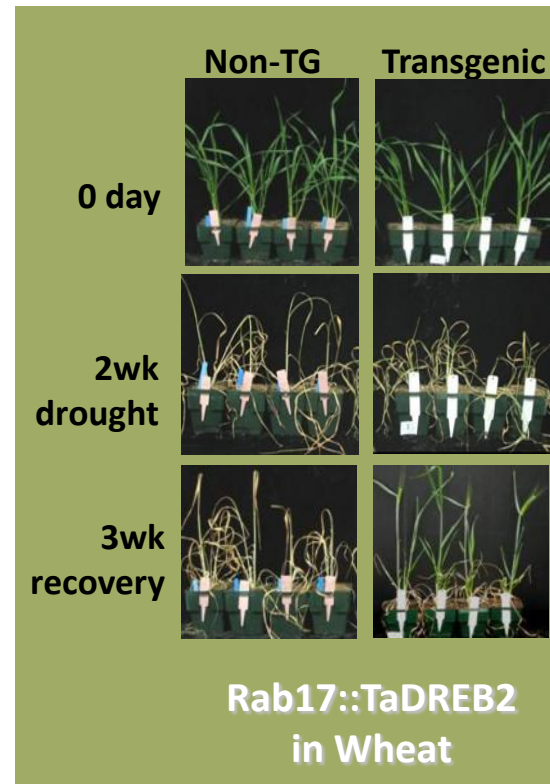
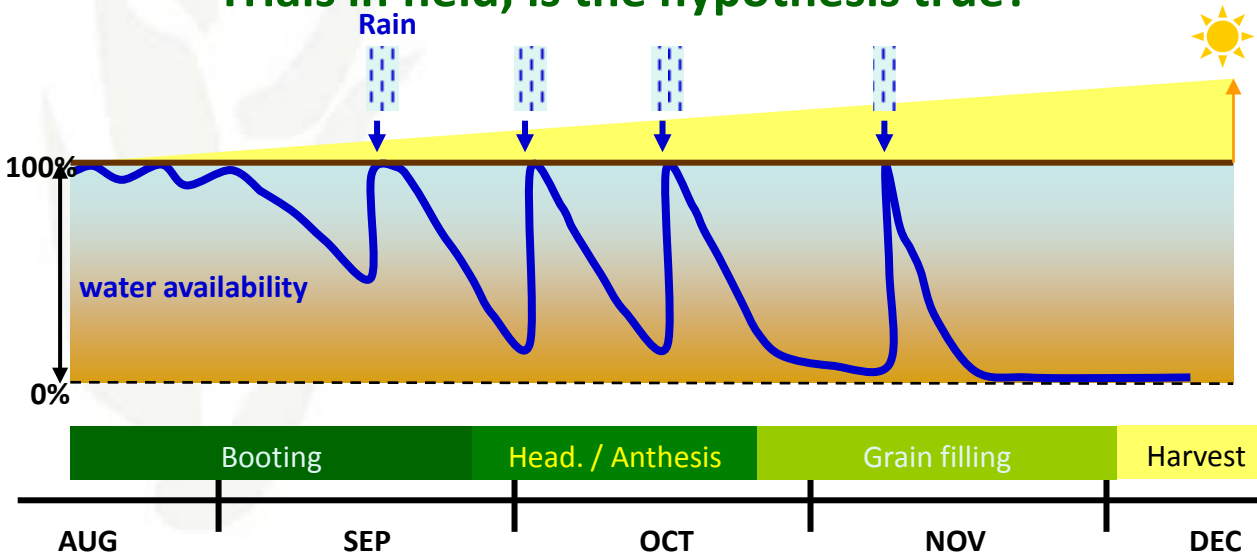


Minnipa

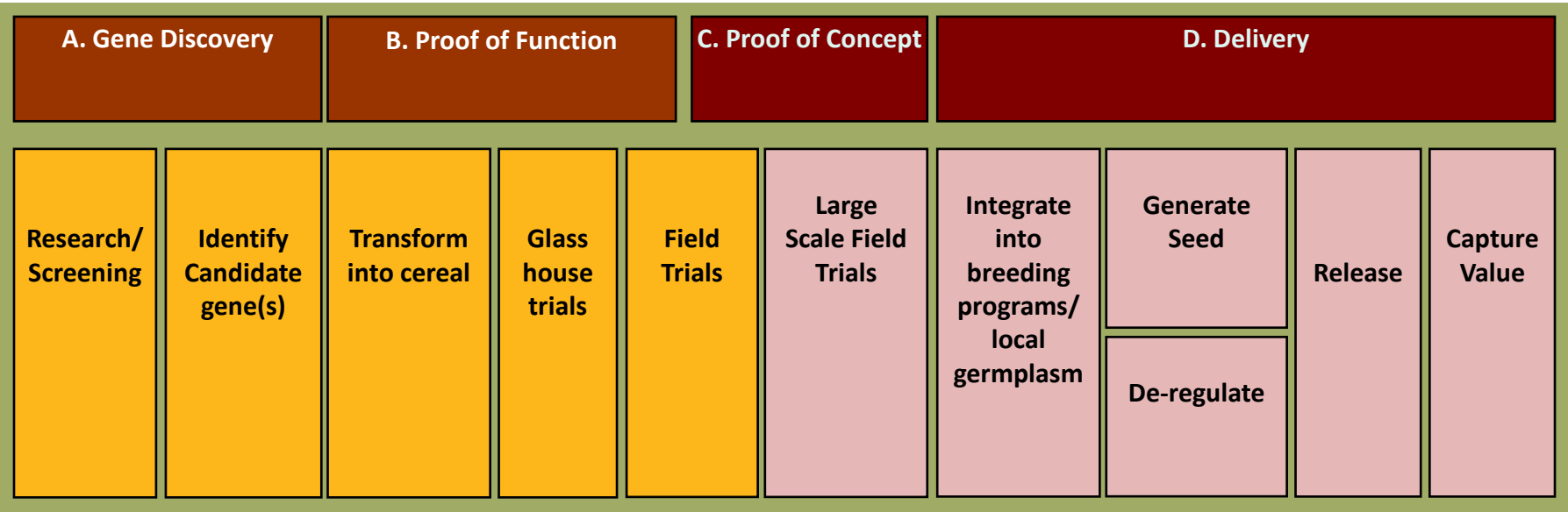


## Candidate gene approach

- Transform gene of interest
- Can link gene with drought inducible promoter
  - (gene turns on only under drought)
- Glasshouse experiments
- Trials in field; is the hypothesis true?



# what is the delivery process for GM ?



Estimated 2006 commercial Biotech R&D expenditure (Oborne, 2009)

Company (Country)	(US\$ millions)
Syngenta (Switzerland)	510
Monsanto (USA)	470
Bayer CropScience (Germany)	310
Du Pont Pioneer (USA)	190
BASF (Germany)	170
LimaGrain (France)	85
KWS SAAT(Germany)	65
Dow Agrosiences (USA)	55
<b>Total</b>	<b>1855</b>



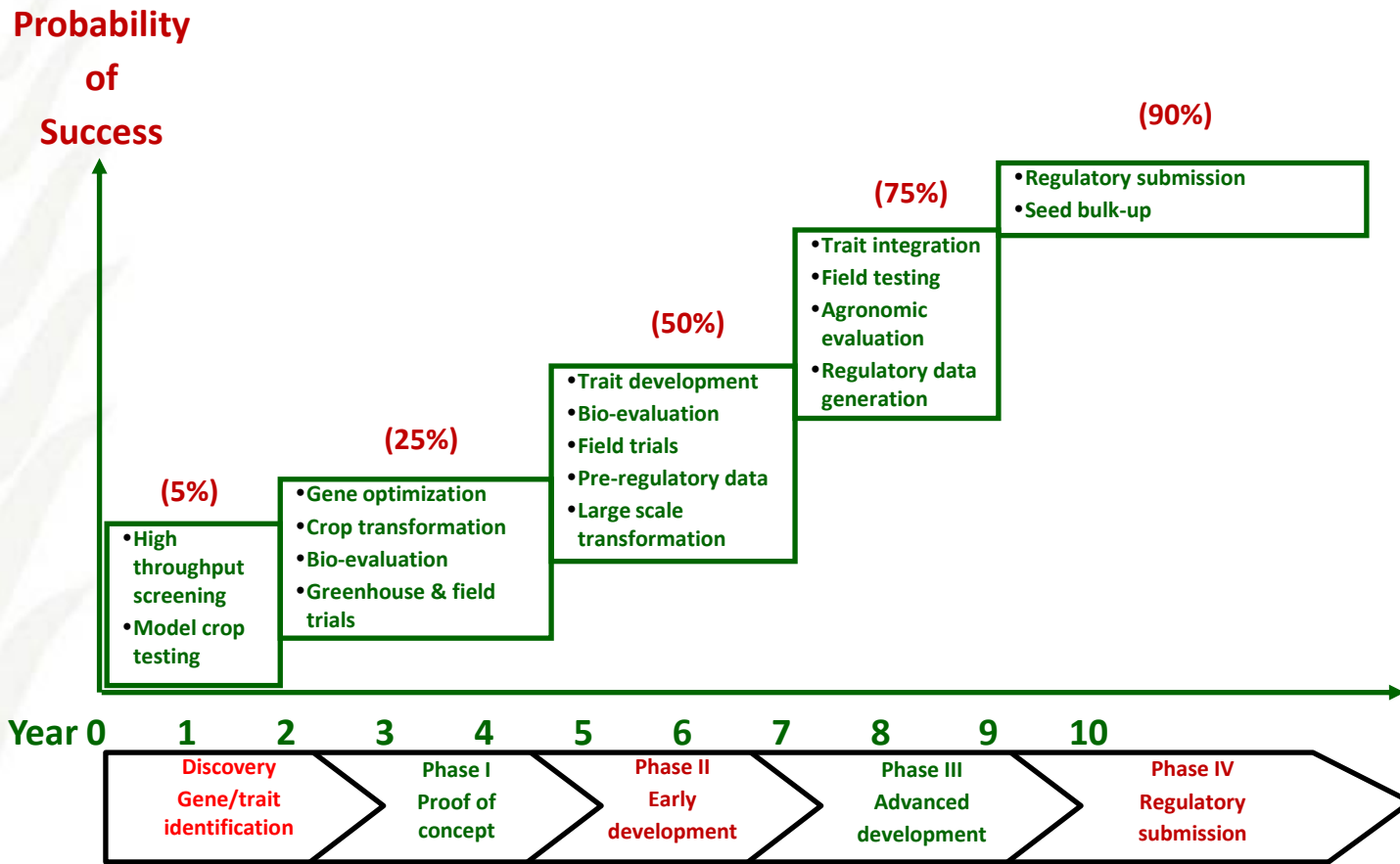
ACPF budget is ~US\$15m per year

**Collaboration with the commercial sector is "a must"**





# what is the probability of success with GM?

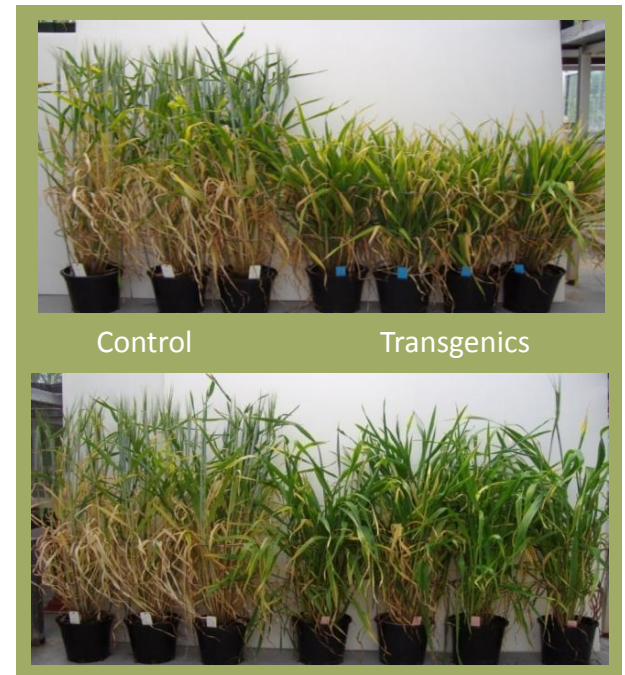


....many thanks to Glenn Tong CEO MPBCRC for this slide



## Bottlenecks

- Glasshouse capacity
- Phenotyping (discerning physical differences in plants)
- Field sites and managing field work
- and of course
  - De-regulation of a new GM variety



# what is the “National Collaborative Infrastructure Research Strategy (NCRIS)”

- Federal Program to establish National Research Infrastructure
- Many projects funded in round 1

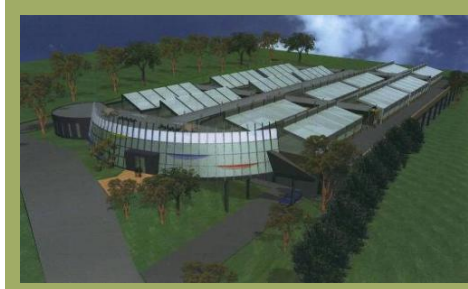
## CASE STUDY

- Plant Phenomics capability initially awarded \$16m by NCRIS and then \$10m

## Two locations

- Supporting funding from
  - SA State Government (\$10m)
  - ANU
  - CSIRO
  - Uni of Adelaide (\$5.9m)
  - Total \$52m

## ADELAIDE (\$32m)



- 3,200 m2 of greenhouses
- 800 m2 automated greenhouses
- 480 m2 growth chambers
- 160,000 plants per year
- high capacity image analysis
- regular, non-destructive measurements of growth, development, physiology
- First public sector facility of this type and scale in the world

## CANBERRA (\$20m)



- Tools to record and analyse key physiological parameters throughout the plant lifecycle
- Field imaging of composition and performance
- 1500m2 “Research Hotel”
- 500m2 controlled growth area
- Integrated imaging capability
- Field station access.
- High throughput model plant Phenotyping facility



# can genetically enhanced crops be grown in Australia?

- ❑ **GM Cotton and Canola** are grown in Australia; and **Carnations**; but these are not directly used for food
- ❑ Australian Federal system allows **GM crops** to be grown after approval
- ❑ **State Governments and GM**; some currently preclude growing GM for market reasons - this will change (we hope!)
- ❑ In the meantime, all Governments actively support and fund the **research**
- ❑ There are **no de-regulated GM cereals** for human consumption anywhere in the world....yet!



"I'm terribly concerned about the health implications of eating GM foods"

# so, what is the summary?

- ❑ World Pressure on food supply
- ❑ Food demand is **up**
- ❑ Wheat supply is **down**
- ❑ Over 40% of world grain is wheat and **none is GM**
- ❑ Australia leads in **wheat research and breeding**
  - ❑ Well positioned to deal with the stressful environments!



**GM Wheat** is a new commercial opportunity; and Australia is potentially at the forefront; we need to engage internationally

# what's next?

❑ Major international companies turning toward

**GM wheat**

❑ Significant amounts of money are being committed to establish GM wheat businesses

❑ Big companies jostling; asset prices rising; paying a lot to get a “position in the game”

❑ How do we deliver GM technologies in Australia? That is the challenge.

❑ In the meantime

❑ continue biotechnology research; without that, we will become **uncompetitive**

❑ maintain scientific foundation for **conventional breeding**

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Tuesday, July 21, 2009

Long-term cooperation with leading Australian research institute CSIRO:

## **Bayer CropScience expands global R&D activities in seeds and traits by setting up new research focus area in cereals**

Superior solutions for wheat farmers could be available as early as 2015

Monheim, July 21, 2009 – Bayer CropScience is expanding its global research and development activities in seeds and traits to include a focus on cereals. In support of this expansion, the company recently formalised a long-term alliance with the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia's national research organization, which is one of the world's leading institutions in the development of new wheat varieties.

The agreement establishes a far-reaching joint research and development program between CSIRO and Bayer CropScience, aimed at improving the productivity and sustainability of cereal production utilizing modern techniques. The cooperation will broaden the strong research and development basis of Bayer CropScience's seeds and traits business, which is currently focused on cotton, canola, rice and vegetables. The company also offers innovative trait solutions for the soybean and corn seed industry.

Bayer CropScience has a global market leadership position in crop protection solutions for cereals that combat plant diseases, pests and weeds, and regulate plant growth. The company now intends to further complete its portfolio by developing improved plant characteristics for wheat. With about 25% of the global agricultural land under wheat cultivation, it is the largest cereal crop in terms of acreage and one of the world's most important staple foods.

Both parties will set up a number of research and development projects in the area of traits and their introgression into cereal germplasm, the goal being to develop cereal varieties with higher yield, more efficient nutrient utilization and tolerance against abiotic stress such as drought. One of the initial projects of this collaboration is dedicated to the development of wheat lines with improved yield potential and stress tolerance, while another focuses on wheat lines with improved utilization of phosphorus. These and other research projects are expected to result in new varieties available to farmers from 2015 onwards.

Financial terms of the agreement were not disclosed.



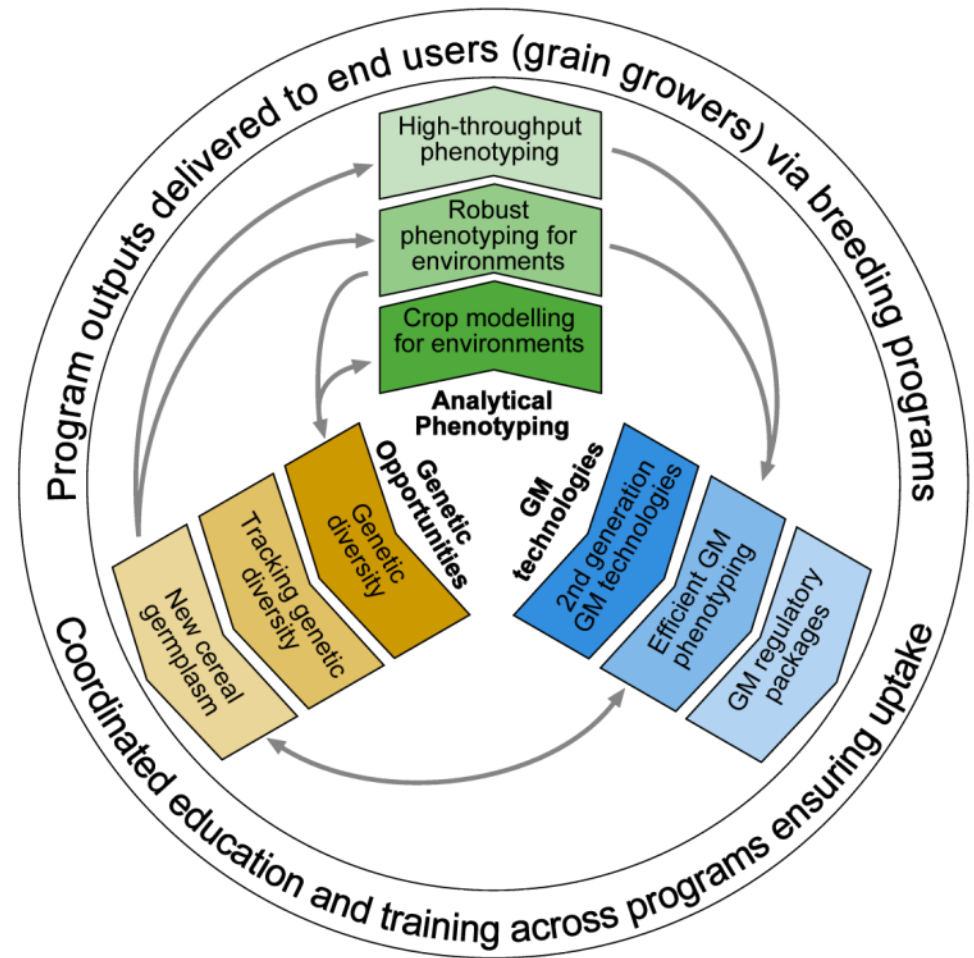
# what's next?

A new CRC is proposed, focussed on cereals.  
*“to support the development and delivery of genetic and related technologies to the Australian cereals industry”*

- research proposals submitted last week
- interview November 30<sup>th</sup> this year
- notification of success late December
- mid 2010 commencement
- \$50m/10yrs

## Partners

- CSIRO, Plant Industry
- University of Adelaide/ACPF
- Southern Cross University
- Departments of Agriculture
  - Queensland (QDPI&F)
  - NSW (NSW DPI)
  - Victoria (Vic DPI)
  - South Australia (SARDI)
  - Western Australia (DAFWA)
- CIMMYT
- ICARDA



# thanks for listening!



## ACKNOWLEDGEMENTS

The many organisations that I have pinched data from and forgot to properly reference because I am not a scientist!



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