The Australian Rice Breeding Program: where quality meets quantity

Dr Ben Ovenden, Dr Peter Snell and Dr Jixun Luo

Australian Rice Partnership II project

Australian Rice Quality Symposium, Wednesday 19 July 2017

CSU Wagga Wagga

Aim: Create value and sustainability for rice growers

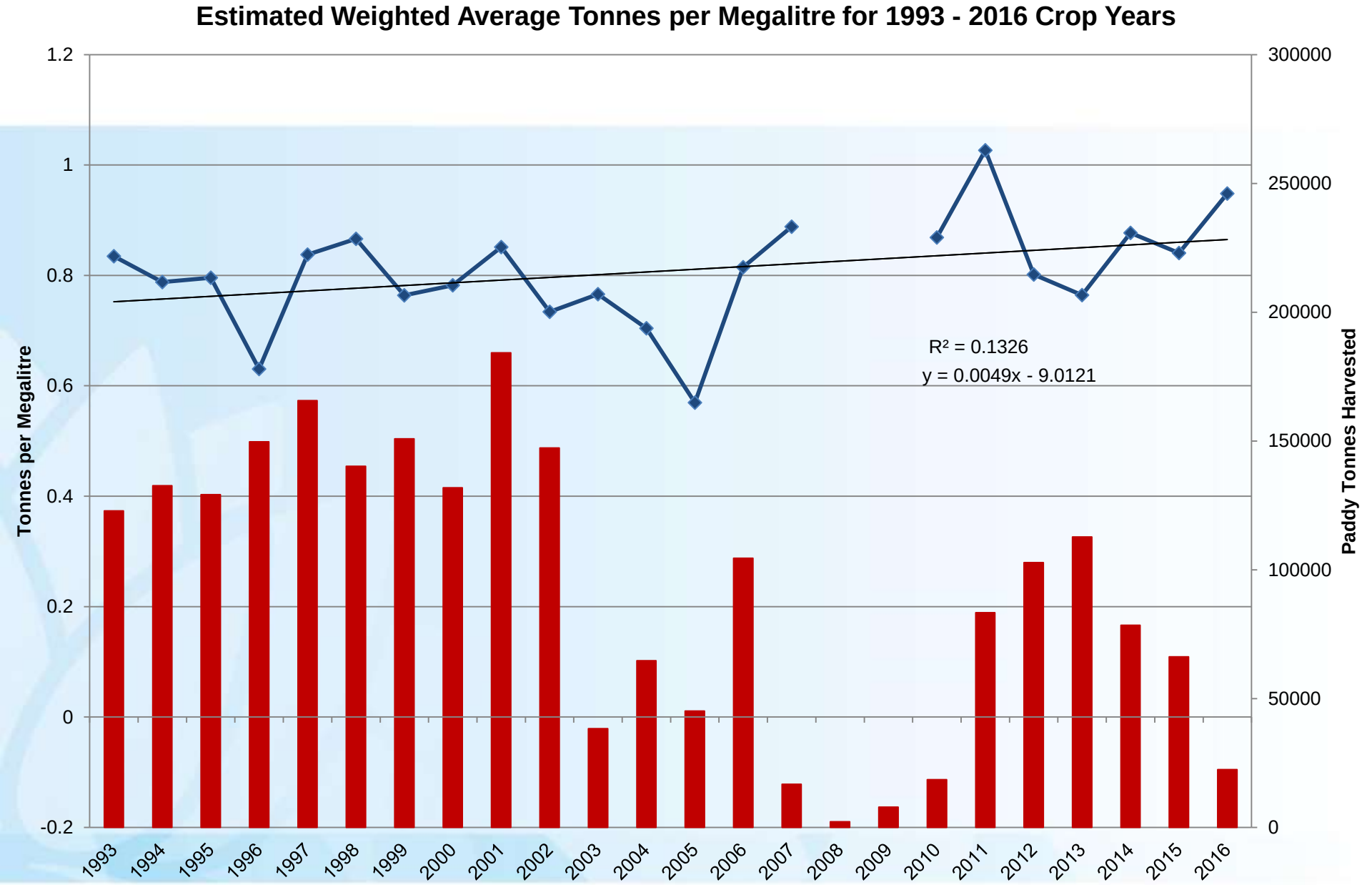
$$Total\ Return = Amount \times Price$$

$$Amount = \frac{Grain\ Yield}{most\ limiting\ resource}$$

Water, WUE

$$Price = category \times grade\ in\ category$$

Quality


Estimated Weighted Average Tonnes per Megalitre for 1993 - 2016 Crop Years
Tonnes per Megalitre
Paddy Tonnes Harvested
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
300000
250000
200000
150000
100000
50000
0
R² = 0.1326
y = 0.0049x - 9.0121
1993
1994
1995
1996
1997
1998
1999
2000
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016

Water Use Efficiency

Target of 1.5t/ML for the whole rice industry:

- 0.5% per year (current rate) = 2099
- 1.0% (double current rate) = 2058
- 1.5% (triple current rate) = 2045

- 3.0% (6x current rate) = 2031

Rice Breeding 2.0

- Focus on performance under reduced irrigation
- Focus on high value quality types
- Focus on increasing rate of genetic gain:

$$\Delta G = \frac{i\, h\, \sigma_A}{L}$$

$$Response = \frac{intensity \times \boldsymbol{accuracy} \times genetic\ var}{generation\ \boldsymbol{time}}$$

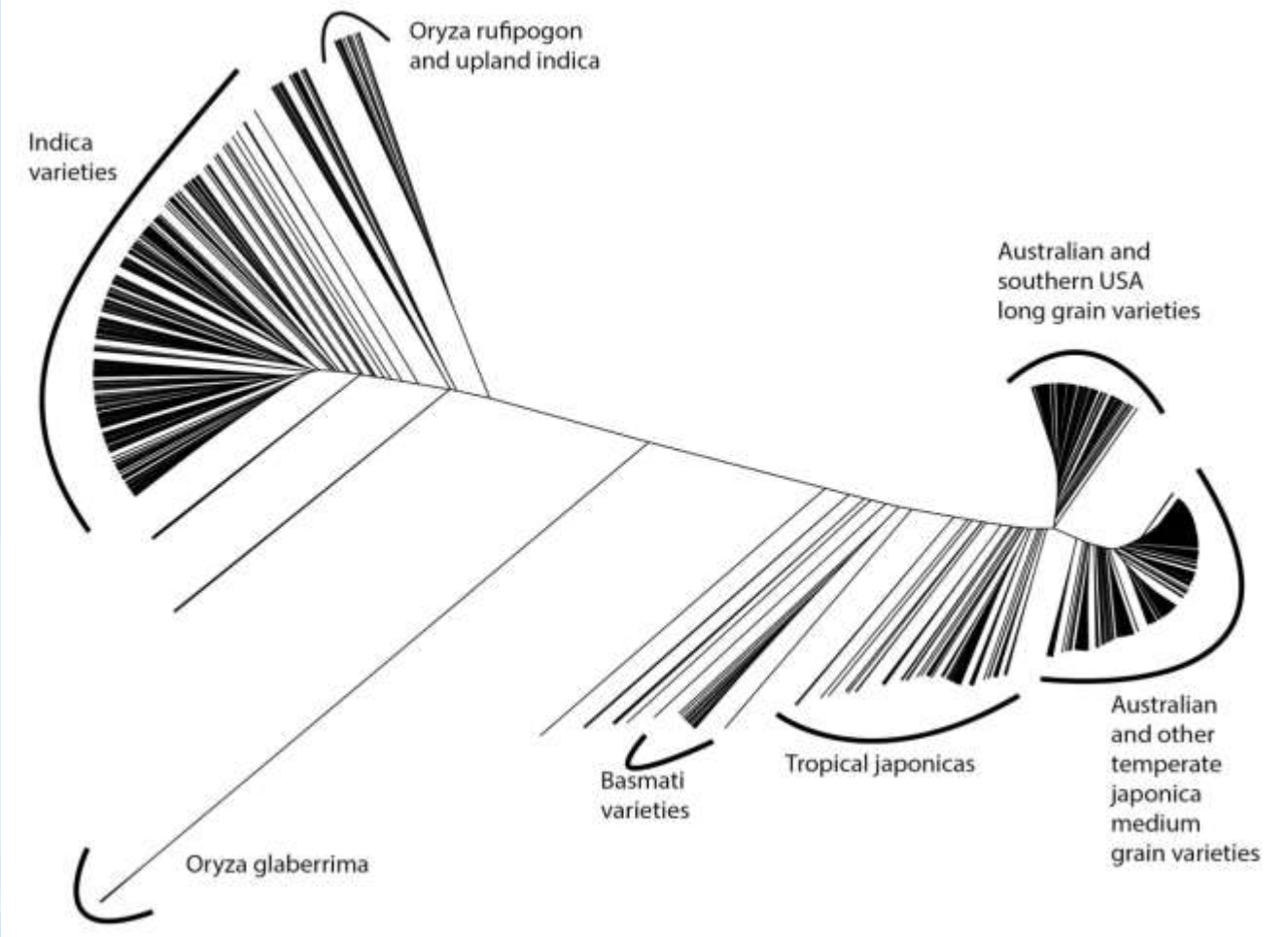
Increasing ***accuracy*** and reducing ***time***

- Markers “early and often”
- Sparse phenotyping (test more lines for yield)
- Analyse co-located trials together
- Increased use of multi-environment trials
- Incorporate A (pedigree) and K (marker) matrix into breeding selection models
- K matrix = transition to genomic selection

Increase ***accuracy*** and reduce ***time*** in rice quality (rice ***price***) selection

1. New quality categories
    - Low GI medium grain
2. Better quality in existing categories
    - Reduced cracking, chalk
    - Optimal cooked rice texture, aroma
3. MAS enrichment of quality alleles
    - So that breeding program germplasm screened for cold, aerobic performance already has essential combo of quality traits

Yanco Germplasm Collection



Mapping populations

- Yanco Core Set
  - 250 diverse japonica lines
  - Association Mapping / GWAS
  - 30,000 SNPs

- Baru x M205
- Teqing x Lemont
- Basmati 370 x Doongara
- Purple x Sherpa
- Reiziq x Kyeema
- Sherpa x Doongara
- …