Water Smart Farming Systems – in water limited environments

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Field level water productivity

T = WU - Es

B = T x TE

Y = B x HI

- Transpire more of that water supply
  - Water use before and after flowering
- Increase transpiration efficiency (10%)
- Convert more of the biomass into grain (0-50%)
  - Transfer of water use (G x M)
  - Stresses around flowering (G x M x E)
  - Tillering & stay green (G x M x E)
  - Translocation of assimilates (G)?

Water supply / demand ratio

Degree days from flowering

Genotype x Management x Environment
Field level water productivity

$G \times M \times E = 12 \text{ hybrids} \times 3 \text{ densities} \times 2 \text{ configurations} \times 8 \text{ sites} \times 2 \text{ years}$

Ferrante, McLean, Eyre and Rodriguez, 2016
Informing crop design \((G \times M)\)

### Simple rules for farmers

- **Tillering (T)**: (High T, Moderate T)
  - YES: 3.6 t ha\(^{-1}\) \(n=192\) 66%
  - NO: 4 t ha\(^{-1}\) \(n=99\) 34%

- **Density (< 80k plants ha\(^{-1}\))**
  - YES: 5.6 t ha\(^{-1}\) \(n=129\) 48%
  - NO: 8.8 t ha\(^{-1}\) \(n=151\) 52%

- **Configuration type (Single Skip)**
  - YES: 3 t ha\(^{-1}\) \(n=60\) 21%
  - NO: 3.9 t ha\(^{-1}\) \(n=132\) 45%

- **Maturity type (Medium-late, late)**
  - YES: 8.1 t ha\(^{-1}\) \(n=54\) 36%
  - NO: 9.1 t ha\(^{-1}\) \(n=97\) 64%

### APSIM and climate tools

- **Environmental index**
  - Below median EI: 3.8 t ha\(^{-1}\) \(n=291\) 100%
  - Above median EI: 7.3 t ha\(^{-1}\) \(n=290\) 100%

- **Yield (kg ha\(^{-1}\))**
  - Capella: 1.00
  - Gatton: 0.75
  - Warwick: 0.50
  - Jimbour: 0.25
  - Kupunn: 0.00

- **Cumulative probability**
  - ISW Above: 0
  - ISW Below: 2.5
  - ISW and POAMA: 5
  - POAMA: 7.5
  - Above: 10

- **Grain yield (t ha\(^{-1}\))**
- **Configuration type (Single Skip)**
  - YES: 3.8 t ha\(^{-1}\) \(n=291\) 100%
  - NO: 4 t ha\(^{-1}\) \(n=99\) 34%

- **Maturity type (Early, Medium-early)**
  - YES: 7.3 t ha\(^{-1}\) \(n=151\) 52%
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Field level productivity is not enough

Efficiency gains & multiple functions of agriculture
Summary

We need more integrative analyses that inform practice, the public and policy on the benefits and trade-offs from alternative uses of available resources to:

• Bridge and build projects across disciplines
• Improve risks management and capture opportunities
• Focus on efficiency gains & the reduction undesirable impacts
• Quantify benefits other than productivity
“Never before has our world population grown so fast. Never before have so many people had so much money to spend on consumption. Never before has the projected demand for more resources, energy, raw materials, and food been so high.

And never before have our global economies destroyed so much of our natural resources and ecosystems, leaving hundreds of millions of people behind in poverty”