Tropical Pulses for Queensland

Brett Williams
Novel chemical pre-treatment

Abiotic stress tolerant and Botrytis resistant chickpea

Biofortified chickpea with enhanced Fe content

Genotype X Environment X Management modelling

Nested Association Mapping of Mungbean
Pillar 1:

Chemical pre-treatment as a novel strategy to enhance stress tolerance and growth rates

Michael Dodt
Sagadevan Mundree
Brett Williams
Rex Williams
Yash Chauhan
Rationale

- Cost-effective and fast alternative to increase stress tolerance
- Only a single application is required
- Plant-derived, safe, non-toxic
- Climate change predicts regular stress environments in the future

Hough & Rogers, 2014
Strategy
ATW1124 Pre-treatment Enhances Fine Root Development and Harvest Index

n=4
Outcomes

- Determined ATW1124 is effective on mungbean and chickpea
- Increased root/shoot ratio
- Improved photosynthetic activity
- Optimized treatment for commercial varieties and observed a 20% in harvest index
- Potential application for incorporation into new management schemes such as narrow row planting
Pillar 2:
Generation of elite chickpea varieties for enhanced stress tolerance and resistance to *Botrytis cinerea*

Sudipta D. Bhowmik
Alam Cheng
Hao Long
TJ Higgins
Brett Williams
Sagadevan Mundree
Strategy

Transformation

In vitro grafting

Post-acclimatisation
Outcomes
Pillar 4: 
Iron biofortification of chickpea

Grace Tan
Sudipta Das Bhowmik
My Linh Hoang
Peraj Karbaschi
Alam Cheng
TJ Higgins
Brett Williams
Alex Johnson
Sagadevan Mundree
Rationale

(Kassebaum, 2016)
Strategy

\[ \text{Fe content} + \text{Fe bioavailability} = \text{Genes from chickpea, rice and soybean} \]
Iron content in chickpea leaves

Iron content in chickpea seeds

Concentration (ppm)
Pillar 5:
Mungbean Nested Association Mapping Population

Tom Noble, QUT,

Col Douglas, DAF,
Strategy

• Sequenced 560 unique accessions to identify 70 000 molecular markers

• Compared the sequencing data to identify genetic diversity

• Implemented a rapid protocol to breed up to 4 generations a year
Grouping of DNA ‘fingerprints’
(Diversity analysis)

Large-seeded shiny green

HB resistant parents

Wild types
Outcomes

• 24 NAM donor parents selected
  – Widest genetic diversity and morphological traits
  – Phenotyped for key foliar diseases

• Crossed to commercial variety Crystal to create the NAM

• 1440 recombinant inbred lines through single seed descent

• Identified a need for increased diversity in Halo blight resistance
Optimisation of Genotype x Environment x Management interactions for increased pulse yield

Yash Chauhan
Rex Williams

Department of Agriculture and Fisheries
Strategy

- The APSIM Chickpea and Mungbean models calibrated and applied
- A world’s first model based protocol for defining agro-ecoregions developed.
- Type of drought and thermal regimes and their frequencies determined
- Genotype x environment x management (GEM) landscapes developed to determine scope enhancing yield in the target production regions
Outcomes

- Yield distributions and risk to production for both crops determined
- Defined growing environments into seven agro-ecoregions of geographically contiguous locations
- Drought and thermal regimes of Queensland characterised
- GEM combinations for representative locations of each agro-ecoregions made
Summary of Outcomes

1) Used a novel chemical pre-treatment to improve chickpea and mungbean root systems at field-scale
2) Delivered stress resilient and disease resistant GM chickpea lines
3) Delivered elite GM chickpea lines which increased iron bioavailability
4) Developed a NAM population to transition mungbean breeding into the 21st century
5) Improved simulation modelling to expand chickpea and mungbean production areas
Thank you