Legumes For Sustainable Agriculture

ARC ITRH 2015

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THE UNIVERSITY OF SYDNEY

Legumes for Sustainable Agriculture

- ARC Industrial Transformation Research Hub – ITRH
- ARC Program Goals
  - Discovery-led research
  - Applied research
  - Translational research for industry outcomes
- A GRDC Investment

Australian Government

Australian Research Council

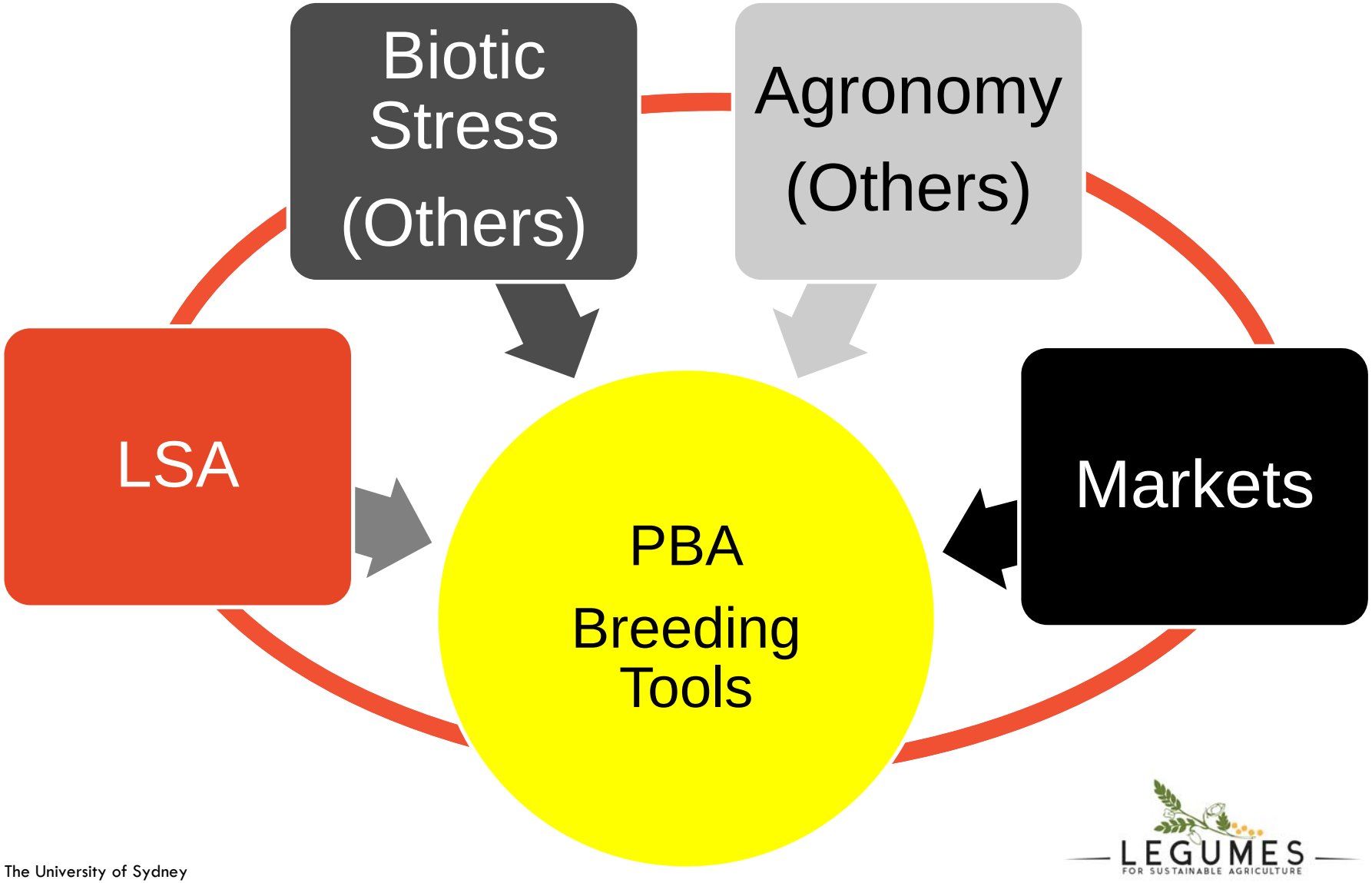
Partnerships and Investors

- ARC, GRDC
- Universities (6)
- State-based agencies (2)
- Wheat Research Foundation
- Impending growth
  - La Trobe, others..
- ~$14.5 million (cash and in-kind)
  - 5 year research program

Legumes for Sustainable Agriculture

- **Purpose of LSA:**
  - Establish a **National Research HUB** focused on improving grain legume productivity and agricultural sustainability
  - Capture complimentary plant-based skills and re-position for a **Grain Legume Focus**
    - Plant Physiology
    - Biochemistry and Molecular Biology
    - Symbiotic biology and soil interactions
    - Genetics and genomics
    - Pre-breeding
  - Identify new traits that improve legume productivity in Australia
    - Pre-breeding pipelines to translate discoveries for use by breeders

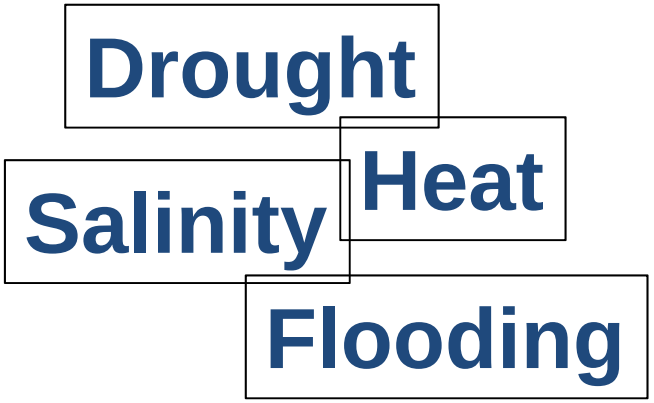
Complimentary R&D within Australia



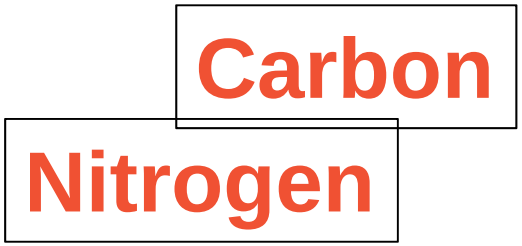
LEGUMES FOR SUSTAINABLE AGRICULTURE

LSA Research Aims

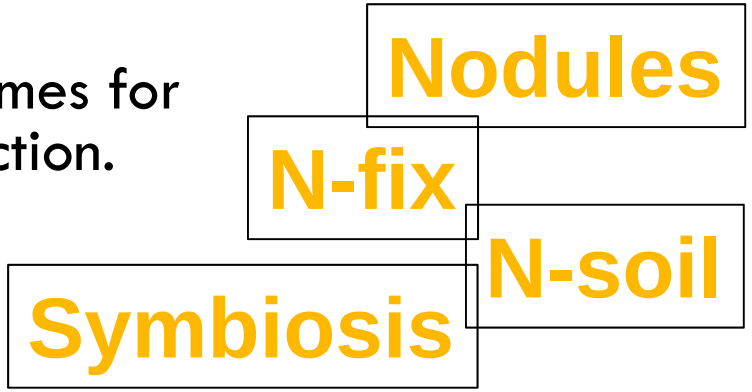
- Develop grain legumes for increased resilience to abiotic stress.



- Optimise plant resource partitioning to enhance the efficiency of yield production under stress.

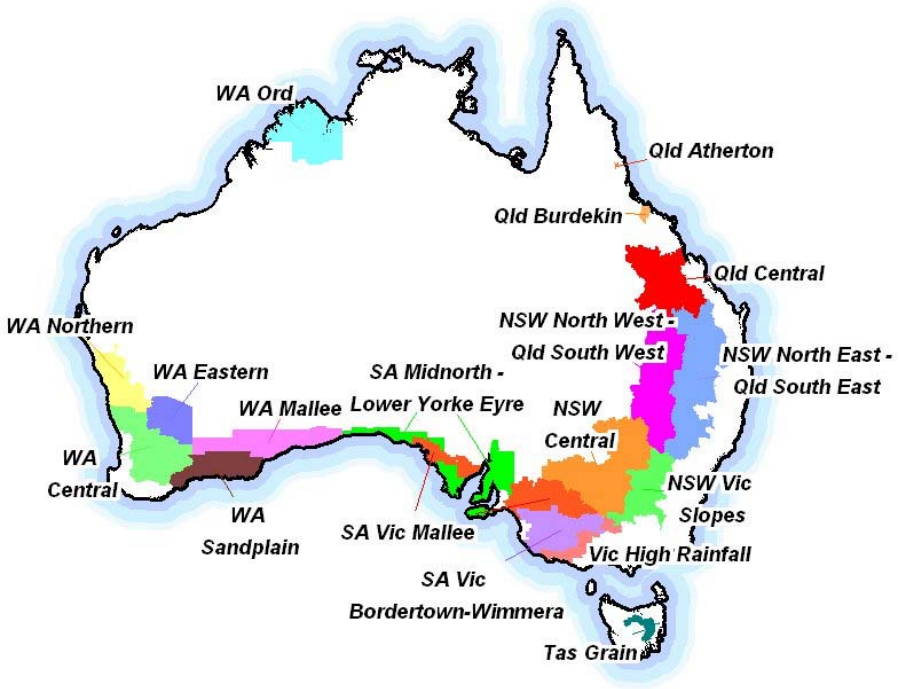


- Enhance N_2-fixation of grain legumes for annual and rotational crop production.



Research Locations

- **Narrabri –** IA Watson Grains Research Centre
- **Sydney –** Camden campus, Australian Technology Park, Lansdowne, PBI Cobbitty
- **Canberra –** ANU campus
- **Adelaide/SA –** UA Waite campus, Flinders University
  - Southern regional field sites
- **Perth/WA –** UWA Campus
  - Western regional field sites
- **Others –** QLD, Victoria



LEGUMES FOR SUSTAINABLE AGRICULTURE

Who is involved?

- Lead Agency – University of Sydney
  - Director: Brent Kaiser
  - Deputy Director: Richard Trethowan
- Chief Investigators
  - USyd: B Kaiser, R. Trethowan, M. Barbour, H. Bramley, A. Merchant, P. Smith, R. Deaker, M. Adams
  - UWA: T. Colmer
  - UA: M. Denton
  - SARDI: T. Sutton
  - ANU: U. Mathesius
  - Flinders: D. Day (also USyd)

Who is involved?

- Partner Investigators
  - GRDC: Juan Juttner
  - NCSU: D. Bird
- Additional Researchers
  - 13 postdoctoral scientists
  - M. Unkovich (UA) - consultant
  - Technical support
  - HUB Coordinator
  - PhD students

LEGUMES
FOR SUSTAINABLE AGRICULTURE

Model System: Chickpea

- Is a 'legume of choice' across many growing regions
- Extensive collection of genetic resources already imported into Australia
- Genome sequenced and annotated
- Molecular tools
- Useful rotation for wheat and canola

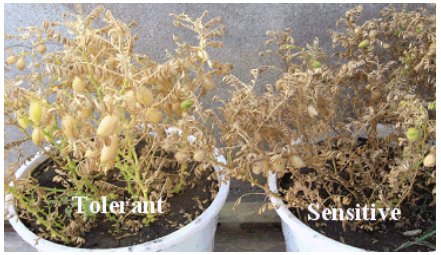
Other legumes?

- Faba bean
- Field Pea

- Models: Medicago and Soybean

Theme 1 - Identify and develop grain legumes for increased resilience to abiotic stress

- **Research Targets**
  - Addressing temperature tolerance during reproductive growth
  - Minimizing the impact of extended drought
  - Improving salinity tolerance in chickpea
  - Improving flooding tolerance to mitigate root disease
  - Defining tools to manage legume oxidative stress

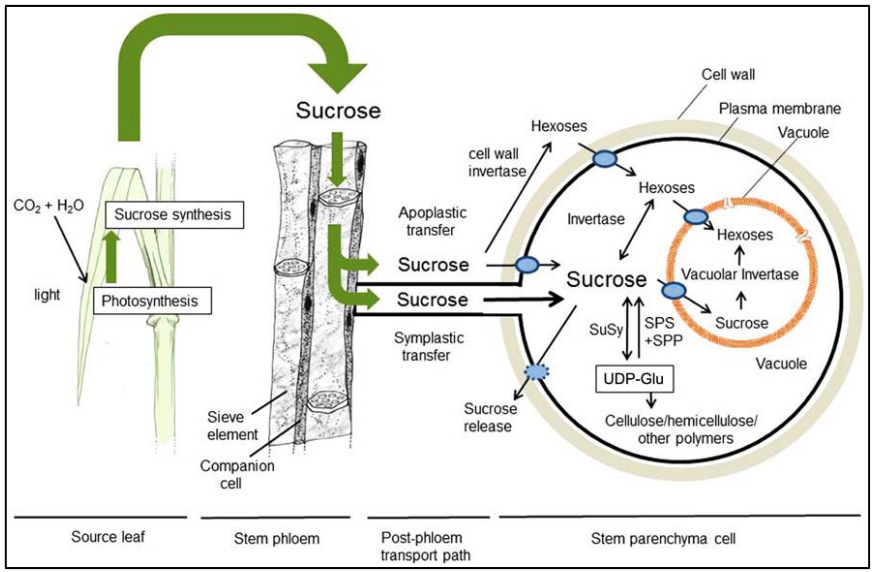


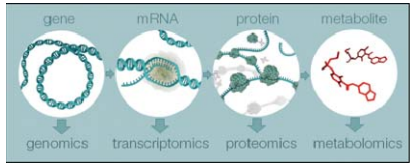
Theme 2 - Resource partitioning under stress

Research Targets

- Identify **biomarkers** for growth and yield under stress
  - Leaf-based tools to predict stress tolerance
  - C and N biomarkers

- Modelling and physiological testing of C-gain, NUE and WUE

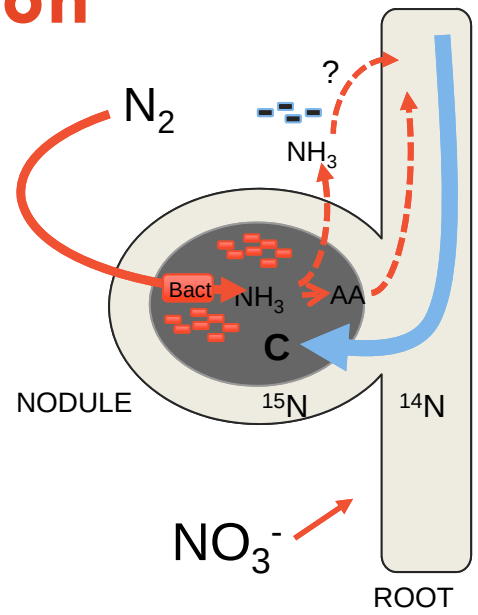


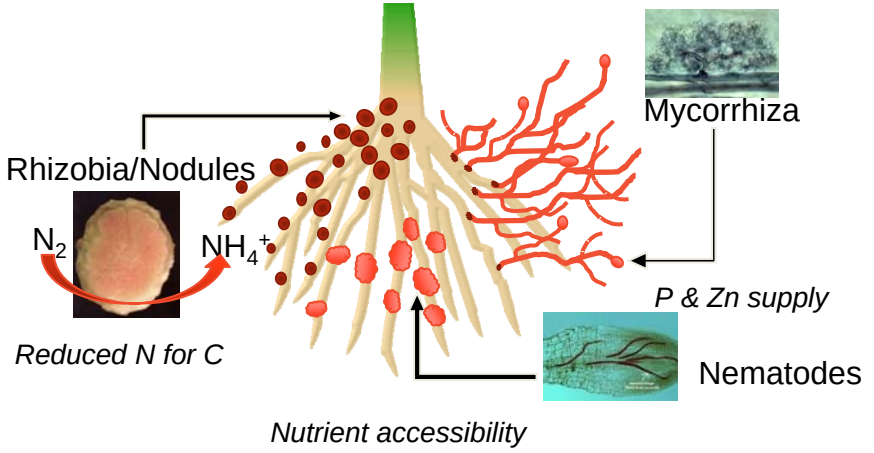


Theme 3 - Enhance symbiotic N_2-fixation

Research Targets

- Improve nodule N_2-fixation efficiency
- Plant support of the legume rhizobia symbiosis
- Develop diagnostic tools to quantify soil N delivery from N_2-fixing plants
- Increase rhizobia effectiveness and perseverance in hostile soils
- Understand and manage symbiotic (Rhizobia, AM fungi) and parasitic interactions (nematodes)





Legumes for Sustainable Agriculture

Expected Outcomes

- Identify and deliver basic discoveries that benefits growers
  - Novel trait discovery
  - Productive traits
- Development of improved germplasm
  - Abiotic stress tolerance (temperature, drought, flooding, nutrient availability)
  - Effective N_2-fixation capacity and soil N deposition
  - Legume rotational benefits: yield increases, N deposition and follow on crop enhancement
- Increased environmental stewardship
- <u>Increased grower profitability</u>

N_2-FIX YIELD HEAT

DROUGHT NUE WUE

Where are we now?

- Official Launch
  - Oct 24th, 2016
- Appointment of staff
- 2016 germplasm collection and seed bulking
  - Mapping populations
  - Diversity sets
- Preliminary trials of drought tolerant chickpea
  - 2014-16 (PhD)

LEGUMES
FOR SUSTAINABLE AGRICULTURE

Thankyou!

Australian Government

Australian Research Council