PBA History and Success

Jeff Paull

On behalf of all who have participated in the journey
Overview

• Pulse breeding in Australia pre-PBA
• Structure of PBA
• Best practice breeding chain
• PBA outputs
Australian Pulse Production - Area

Area (ha)

Faba & broad beans
Chick peas
Lentils
Lupins
Peas, dry

FAOSTAT
Pulse Breeding in Australia pre-PBA

• Generally State-based breeding programs
  • Varying degrees of collaboration between organisations within crops
  • Limited collaboration across crops

• Often multiple grants per crop
  • Difficult to administer
  • Breeders had limited control on activities outside own organisation

• Genesis for National programs in 1996
  • Major pulse meeting at Narrabri
  • International experts with experience operating across regions

• Attwood March 2003!
Pulse Breeding Australia

• Commenced in 2006
• Unincorporated joint venture between GRDC, breeding organisations and Pulse Australia

Vision
• To deliver superior pulse varieties for Australian growers to increase total pulse grain production and the total cropping area sown to pulses
PBA Objectives

• Provide superior varieties that compete in global markets
• Meet the needs of food, feed and special purpose end-users
• Coordinate and recommend release of varieties
• Contribute to education and training related to pulse breeding
• Foster exchange of IPR among the Parties
• Exploit synergies and avoid duplication
• Encourage commercialisation of varieties that provide overall advantages to the Australian Pulse industry
Location of Breeding Programs

<table>
<thead>
<tr>
<th>Region</th>
<th>Dominant Pulse Crop (Current)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Western</td>
<td>Lupin</td>
</tr>
<tr>
<td></td>
<td>Field pea</td>
</tr>
<tr>
<td>Northern</td>
<td>Chickpea</td>
</tr>
<tr>
<td></td>
<td>Faba bean</td>
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<tr>
<td>Southern</td>
<td>Lentil</td>
</tr>
<tr>
<td></td>
<td>Faba bean</td>
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<td></td>
<td>Field pea</td>
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</tbody>
</table>

Germplasm enhancement (SARDI)
Faba bean breeding (UA and Narrabri)
Lupin breeding joined in 2011 (DAFWA)
Lentil breeding (Vic DPI Horsham)
Field pea breeding (Vic DPI Horsham)
Chickpea breeding (NSW DPI Tamworth & Vic DPI Horsham)
Supporting Pulse RD&E
- Pathology
- Agronomy
- Statistics
- Germplasm Enhancement

PBA Commercial Partners
- Sustainable Farming Systems
- Variety Adoption
- PBA Breeding Programs
  - Lentils
  - Chickpeas
  - Faba beans
  - Field peas
  - Lupins

PBA Breeding Programs
- Supporting Pulse RD&E
- Germplasm Enhancement

PBA RAGs
- National Variety Trials (NVT)
- Variety Adoption
- PBA Commercial Partners

Growers
- International
- Domestic

Market Needs
- Seed Industry
- Pulse Australia

Pulse Australia
Australian Best Practice Breeding Chain

- Clearly identified and communicated organisational breeding goals.
- Effective technical breeding target setting, performance criteria.
- Communication - development and maintenance of continuous feedback loops.
- Accessing, capturing and effectively managing IP at each step along the program chain.
- Implementation of effective cost (financial) structures.
- Contractual management skills.

Communication and Feedback - overarching and between the program segments

- Leadership and management from pre-breeding to customer – may be one or more (team) people and include as experienced breeder.
- National and International outlook and understanding of germplasm and technology across the program.
- Change capacity/management across whole chain.
- Effective data management
- Use of fast variety release timetable targets.

Chain Leadership

- Competencies

Operational Activities

- Linkage & management

Pre-Breeding Research

- Breeding Process

Commercialisation

- Variety Uptake

Customers

Timelines (yrs)

- 3 to 5 years
- 4 to 10 years
- 2 years
- 2 to 4 years
- 5 to 10 years

Pure seed management – pedigree seed

Bulk-up

100 to 1000 ton
Breeding Process

**Lead Agency**

Breeder and Technical support
- Report to GRDC
- Overall program management
- Member of PBA Coordination Group
- Crossing
- Early generation multiplication and selection
- S1 – S4 trials
- Pathology, Quality
- Coordinate Statistical analysis (SAGI)
- Initial seed multiplication
- Commercialisation, PBR

**Partner Agencies**

Contribute in a range of areas
- Participate in Breeding Team Management meetings
- Member of PBA Coordination Group

Regional evaluation
- S2, S3, S4
- Provide data for MET analysis
- Identify lines adapted to region
- Feedback on lines to use as parents

Pathology
Quality

**Contract Service Providers**

- Provide services not available within the Breeding Team
- Contract trials in areas not readily accessed by PBA partners
- Provide data for MET analysis
Germplasm Enhancement Research

• Priorities determined by PBA Coordination Group
• Breeding programs provided germplasm when appropriate
• Regular communication between GE projects and PBA
• Rapid adoption of outputs

• Abiotic, Biotic, Quality, Crop Management, Enabling Technologies
Abiotic
• Heat
• Frost
• Moisture stress
• Boron
• Salinity
• Waterlogging
• Pod drop

Biotic
• Ascochyta
• Botrytis
• Bacterial blight
• Downy mildew
• Stemphyllium
• Rust
• Root lesion nematodes

Crop Management
• Herbicide tolerance

Quality
• Sensory
• Processing

Technologies
• Molecular markers
• Digital analysis
Meeting the Customers Needs

• Most Australian pulses are exported to food markets
• Diverse markets – but driven by Indian sub-continent
• All pulse crops have several “types”
  • Which type for which market?
  • Priority/resources for each type?
Australian Pulse Exports

Source: Pulse Australia
Market Intelligence

Local - AGIC  International
Commercialisation

• Each breeding program partnered with a commercial partner to manage a pipeline of varieties
• Early multiplication of promising breeding lines
  • Shorter release times
• Target varieties to appropriate regions rather than compete for market share
• Release Advisory Groups
• Variety Management Package

REFER TO DETAILED INFORMATION AT www.pulseaus.com.au
Ute guides, crop and disease management bulletins
Best Practice

• National and International collaboration
• PBA capacity building
• Communication
  • PBA Newsletter
  • Annual meetings
  • Technicians symposiums
  • PBA Conference 2013, APC 2016
PBA Outputs

• 34 PBA Varieties
• Continuing yield improvements in all crops
• Large pool of elite germplasm
• New traits and selection methods available to breeding programs via GE program
• Integrated breeding programs with a common goal
• Average yield gain of 1-1.5% per year across 20 years

• Tall trailing types gradually replaced with semi dwarf varieties

• Significant breakthrough with cv. Kaspa in 2002
## Faba bean

<table>
<thead>
<tr>
<th>Year</th>
<th>Variety</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>PBA Kareema</td>
<td>Broad bean</td>
</tr>
<tr>
<td>2011</td>
<td>PBA Rana</td>
<td>Southern Region faba bean</td>
</tr>
<tr>
<td>2011</td>
<td>PBA Warda</td>
<td>Northern Region faba bean</td>
</tr>
<tr>
<td>2014</td>
<td>PBA Samira</td>
<td>Southern Region faba bean</td>
</tr>
<tr>
<td>2015</td>
<td>PBA Nasma</td>
<td>Northern Region faba bean</td>
</tr>
<tr>
<td>2015</td>
<td>PBA Zahra</td>
<td>Southern Region faba bean</td>
</tr>
</tbody>
</table>
Faba bean

PBA Samira

• High yielding and widely adapted throughout the Southern Region
• Resistant to ascochyta blight
• Medium size, bright seed suited to Egyptian market
## Chickpea

<table>
<thead>
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<th>Year</th>
<th>Variety</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>PBA HatTrick</td>
<td>Desi</td>
</tr>
<tr>
<td>2009</td>
<td>PBA Slasher</td>
<td>Desi</td>
</tr>
<tr>
<td>2011</td>
<td>PBA Boundary</td>
<td>Desi</td>
</tr>
<tr>
<td>2011</td>
<td>PBA Pistol</td>
<td>Desi</td>
</tr>
<tr>
<td>2012</td>
<td>PBA Striker</td>
<td>Desi</td>
</tr>
<tr>
<td>2013</td>
<td>PBA Maiden</td>
<td>Desi</td>
</tr>
<tr>
<td>2013</td>
<td>PBA Monarch</td>
<td>Kabuli</td>
</tr>
<tr>
<td>2016</td>
<td>PBA Seamer</td>
<td>Desi</td>
</tr>
</tbody>
</table>
Chickpea

PBA Seamer

• Highest level of AB resistance in desi adapted to northern region
• Improved lodging resistance
• Larger seed and improved milling quality
• Released in 2016 with strong interest from northern growers
# Field pea

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<tr>
<th>Year</th>
<th>Variety</th>
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</tr>
</thead>
<tbody>
<tr>
<td>2011</td>
<td>PBA Gunyah</td>
<td>Kaspa</td>
</tr>
<tr>
<td>2011</td>
<td>PBA Twilight</td>
<td>Kaspa</td>
</tr>
<tr>
<td>2012</td>
<td>PBA Hayman</td>
<td>Forage</td>
</tr>
<tr>
<td>2012</td>
<td>PBA Percy</td>
<td>Dun</td>
</tr>
<tr>
<td>2012</td>
<td>PBA Oura</td>
<td>Dun</td>
</tr>
<tr>
<td>2013</td>
<td>PBA Pearl</td>
<td>White</td>
</tr>
<tr>
<td>2014</td>
<td>PBA Coogee</td>
<td>Forage</td>
</tr>
<tr>
<td>2014</td>
<td>PBA Wharton</td>
<td>Kaspa</td>
</tr>
</tbody>
</table>
Field pea

PBA Pearl

• Highest yielding Australian pea

• Yellow pea – market is 100 fold larger than Dun pea market

• Downy mildew and BLRV resistant

• Good early vigour, early-mid flowering and maturity
# Lentil

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<thead>
<tr>
<th>Year</th>
<th>Variety</th>
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</tr>
</thead>
<tbody>
<tr>
<td>2009</td>
<td>PBA Flash</td>
<td>Medium red</td>
</tr>
<tr>
<td>2010</td>
<td>PBA Jumbo</td>
<td>Large red</td>
</tr>
<tr>
<td>2010</td>
<td>PBA Blitz</td>
<td>Large red</td>
</tr>
<tr>
<td>2012</td>
<td>PBA Ace</td>
<td>Medium red</td>
</tr>
<tr>
<td>2012</td>
<td>PBA Bolt</td>
<td>Medium red</td>
</tr>
<tr>
<td>2013</td>
<td>PBA Hurricane XT</td>
<td>Small red</td>
</tr>
<tr>
<td>2014</td>
<td>PBA Greenfield</td>
<td>Medium green</td>
</tr>
<tr>
<td>2014</td>
<td>PBA Giant</td>
<td>Large green</td>
</tr>
<tr>
<td>2014</td>
<td>PBA Jumbo2</td>
<td>Large red</td>
</tr>
</tbody>
</table>
Lentil

PBA Jumbo2

• Highest yielding red lentil across all lentil growing areas
• Good broad adaptation and yield stability
• Resistant to ascochyta and botrytis grey mould, so suitable for early sowing
• Improved tolerance to boron
## Lupin

<table>
<thead>
<tr>
<th>Year</th>
<th>Variety</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>PBA Gunyidi</td>
<td>Australian sweet lupin</td>
</tr>
<tr>
<td>2013</td>
<td>PBA Barlock</td>
<td>Australian sweet lupin</td>
</tr>
<tr>
<td>2015</td>
<td>PBA Jurien</td>
<td>Australian sweet lupin</td>
</tr>
</tbody>
</table>
Lupin

PBA Jurien

• High yielding across most lupin growing areas in WA, NSW, SA and Vic

• Resistant to Anthracnose

• Resistant to phomopsis and grey spot
Challenges for the Future

• Fill-in the production area gaps
• Integrate new traits and technologies into the breeding programs
  • Reassess selection priorities
  • Capacity within breeding programs or out-source?
• Evolution of pathogens
  • Recognise and respond
• Respond to changing market requirements
• Respond to changing farming systems
Participants
Grains Research and Development Corporation
Pulse Australia
University of Adelaide
Agriculture Victoria
NSW Department of Primary Industries
South Australian Research and Development Institute
Queensland Department of Agriculture, Fisheries and Forestry
Department of Agriculture and Food, Western Australia
University of Sydney
Tasmanian Institute of Agricultural Research
Centre for Legumes In Mediterranean Agriculture
Australian Pulse Production - Area

FAOSTAT
Average Total Pulse Production in the SA Midnorth-Lower Yorke Eyre Zone

- Chickpeas: 36%
- Faba Beans: 18%
- Field Peas: 32%
- Lentils: 36%
- Lupins: 10%

Average Total Pulse Production in the SA Vic Mallee

- Chickpeas: 44%
- Faba Beans: 8%
- Field Peas: 4%
- Lentils: 36%
- Lupins: 8%

Average Total Pulse Production in the SA Vic Border-Wimmera Zone

- Chickpeas: 29%
- Faba Beans: 12%
- Field Peas: 7%
- Lentils: 11%
- Lupins: 40%

Average Total Pulse Production in the Vic High Rainfall Zone

- Chickpeas: 33%
- Faba Beans: 33%
- Field Peas: 3%
- Lentils: 9%
- Lupins: 50%