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Overview

Pulse Breeding Australia (PBA) coordinates a world class Australian pulse breeding program. It has operated since 2006, with its State Department and University based national chickpea, lentil, field pea, faba bean and lupin breeding programs delivering pulse varieties through best practice breeding for Australian growers.

Vision

Pulses are vital to the creation of sustainable farming systems across Australia. They provide disease breaks for cereal crops, broaden weed control options, reduce reliance on artificial fertilisers and assist with diversifying growers’ production and marketing opportunities.

PBA’s vision is to see pulses expand to greater than 15% of the cropping area to underpin the productivity, profitability and sustainability of Australian grain farming systems.

Objective

PBA’s objective is to breed and drive adoption of a pipeline of improved varieties for Australian growers that achieve higher yields, have resistance to major diseases and stresses, and have grain qualities that enhance market competitiveness.

Partners

Pulse Breeding Australia (PBA) is an unincorporated joint venture between:
- Department of Environment and Primary Industries, Victoria (DEPI Vic)
- South Australian Research and Development Institute (SARDI)
- Queensland Department of Agriculture Fisheries and Forestry (Qld DAFF)
- New South Wales Department of Primary Industries (NSW DPI)
- Department of Agriculture and Food Western Australia (DAFWA)
- University of Adelaide
- University of Sydney
- Pulse Australia
- Grains Research and Development Corporation (GRDC)

Operations

The PBA Board has oversight of PBA and sets its strategy with the PBA Coordination Group - responsible for the operations and day to day managements of PBA. PBA varieties are developed within the PBA breeding programs and delivered via PBA’s commercial partners on approval of the PBA Release Advisory Groups (RAGs). Strong relationships with commercial partners ensure new pulse varieties are delivered as quickly as possible to growers.

PBA targets the breeding of its five winter grain legumes (chickpea, faba bean, field pea, lentil, and lupin) to produce better pulse varieties faster. The capabilities, skills and investment of the PBA partner agencies are used cooperatively to develop superior varieties for growers across the Australian cropping regions.

PBA partners take responsibility for specific breeding processes within each crop, including parental line identification, crossing, early generation evaluation and line selection, screening for quality, development of resistance to diseases and tolerance to abiotic stresses, widespread evaluation to identify broad and local adaptation and providing agronomic support.
PBA Highlights 2012

Variety delivery

Following renewal of the PBA joint venture agreement, 2012 saw the first full year of PBA’s second phase. Collectively the PBA partners are investing around $11.8 million per year into the PBA breeding programs over the five year term of the new agreement, demonstrating a strong commitment to the continued delivery of better pulse varieties to Australian growers.

In 2012 PBA launched five new pulse varieties. The addition of PBA Pearl (field pea) PBA Warda (faba bean), PBA Striker (chickpea) and PBA Ace and PBA Bolt (lentils) brings the PBA variety stable to a total of 21 varieties launched since 2006.

These varieties include a range of significant benefits over previous benchmark varieties, including higher yield, better disease resistance, better quality attributes and agronomic characteristics. The improved PBA varieties are providing growers in all cropping regions with more options to expand the use of pulses in creating sustainable crop rotations.

The variety releases indicate that the PBA breeding pipelines are working effectively and will continue to develop varieties for both established pulse growing regions and those areas of likely expansion where more challenging growing conditions prevail.

The focus of all the breeding programs was sharpened for PBA’s second phase. As a result over the next few years growers will start to see the release of varieties which incorporate further improvements in key traits and are therefore more robust and better able to deliver consistent results in their target environment.

PBA is linked to a suite of pulse germplasm enhancement projects working on trait discovery, development of specific trait screening methodologies and introgression of traits into adapted breeding lines. 2012 saw the delivery of some new traits to the breeding programs, for example herbicide tolerant lines to the PBA faba bean program. The future delivery of traits and genes to improve current production, expand the existing production area and meet future demands created by climate, practice or pathogen change will ensure the long term viability of the PBA breeding programs.

Critical for adoption, a variety brochure is released with each new PBA variety. The brochures provide information about appropriate agronomic, disease management and disease ratings for each variety. Varietal information is compiled from agronomic and disease management projects funded by GRDC in conjunction with the PBA partner agencies, combined with yield data from variety trials conducted by both PBA and National Variety Trials (NVT).
New PBA Partner

PBA was pleased to welcome the University of Sydney as a new PBA joint venture partner in 2012. The University joined PBA after taking over the northern node of the PBA Faba Bean Breeding Program from NSW DPI. Breeding for the northern faba bean node is now centred at the University of Sydney Plant Breeding Institute’s (PBI) IA Watson Grains Research Centre at Narrabri. Dr Kedar Adhikari, Project Leader Grain Legume Breeding (PBI), leads the faba bean northern breeding effort and has joined the PBA Coordination Group as the University’s representative. Professor Richard Trethowan, Director of the IA Watson Grains Research Centre, represents the University on the PBA Board. The PBA partners are excited by the University’s positive commitment to pulse breeding and are looking forward to developing strong working relationships with the University of Sydney for the betterment of the northern pulse industry.

PBA Inaugural Pulse Conference

PBA’s Inaugural Pulse Conference, to be held in October 2013, was launched in 2012. It is the first pulse research conference to be held in Australia in many years and will bring together growers, agronomists and marketers to interact with both Australian and international pulse researchers. Themed “Expanding Horizons” the conference aims to focus attention on how to meet the PBA vision of expanding pulse production to more than 15% of the total cropping area by seeking innovative solutions to developing better varieties for Australian growers.
Field Days

In association with Pulse Australia and its commercial seed partners PBA launches its new varieties at targeted pulse field days during the pulse spring field day circuit. Launches are accompanied by a variety brochure for each new PBA variety. This gives growers and advisors the opportunity to view and assess the varieties in their growing regions prior to their availability. 2012 was no exception with launches of the new lentil, chickpea, faba bean and field pea varieties across the targeted growing areas of the western and southern regions.

Holding the regional PBA meetings at NSW DPI’s Wagga Wagga Agricultural Research Institute in October 2012 created a unique opportunity for the PBA breeders to participate in a joint NSW DPI/PBA Breakfast Field Day. The day, themed Pulses: New Opportunities Ahead was highly successful with about 90 people attending. The PBA breeders provided field day attendees with an overview of PBA’s breeding programs and answered specific questions from those present. Given the success of having the PBA regional meetings in combination with a field day, PBA will be examining whether this can be achieved in other cropping regions.

Eric Armstrong, NSW DPI and Simon Crane, Seednet examine the pea trial at the Wagga Wagga Field Day (photo: Toni Nugent)
PBA Breeding Programs Report

Chickpea

Key Program Outcome 2016: the delivery of chickpea varieties with higher and more stable yield, fewer input requirements and improved seed quality to significantly increase the profitability of chickpea production.

Highlights 2012

The desi variety PBA Striker® was launched in WA in partnership with Seednet (PBA chickpea’s desi commercial partner). This early flowering and early maturing variety offers a substantial yield increase of 8-9% (based on long term NVT analyses) in WA over the mid flowering variety PBA Slasher® (released 2009). PBA Striker® has improved early vigour and larger seed size than PBA Slasher®. Its ascochyta blight (AB) rating of moderately resistant is lower than PBA Slasher® but greater than Genesis TM 836.

The release of PBA Striker® brings the total number of PBA chickpea varieties released since 2006 to five.

The program continued to develop new breeding material to form the basis of improved adaptation and productivity in future varieties. Lines with improved phytophthora root rot (PRR) resistance have been identified and will assist with improving yield stability. Large seeded high yielding kabuli lines with AB resistance have also been identified. A high yielding, AB resistant and large seeded kabuli variety would be a very profitable crop option for growers, particularly in south eastern Australia where the majority of the kabuli crop is currently grown.

Following a very wet harvest in Victoria in 2010, the germination percentage of seed for all early generation kabuli breeding lines was reduced from 90% to 10%. This resulted in a modified and smaller evaluation program in 2011, which saw SARDI undertake a successful row multiplication and evaluation trial of this material. The harvested seed was used for limited evaluation and also a small amount (300 seeds) was passed to DAFWA, to multiply at Kununurra in 2012. This multiplication was successful, returning up to 5 kg for each line and will bring the evaluation program for these lines back on track in 2013.

The third PBA Technical Symposium was successfully hosted by PBA chickpea staff based at Hermitage Research Station, Warwick Queensland, with participation from all PBA pulse breeding and agronomy teams. Mr Brent Barlow, Research Specialist Professional, from the University of Saskatchewan Canada, attended the symposium as an invited guest.
Outlook 2013

Launches of PBA Striker® are planned for south eastern Australia in 2013.

A review of the agronomic information on all progressing lines will occur at the Chickpea RAG meetings and another two variety releases are possible in 2013.

New operating procedures for the development of early generation kabuli material will be implemented in the 2013 season. The development of early generation kabuli material has suffered from multiple setbacks since the relocation of the program from Horsham to Tamworth. In 2011, natural incidence of PRR at the Tamworth Agricultural Institute resulted in the loss of F2 and F3 populations and F4/5 progeny rows. In 2012 to decrease the risk of PRR, the majority of the kabuli breeding material and international germplasm was moved to Breeza Research Station where it was sown on raised beds. The high incidence of virus which caused a large amount of plant death, followed by severe grazing by ducks and hares compromised the site. Control measures were attempted but were unsuccessful. Alternative options for this material have been investigated and it is hoped that new operating procedures will be in place for the 2013 season.

Evaluation sites will be reviewed in 2013. An improvement in the efficiency of yield evaluation in northern NSW is expected to result from close interactions with the new Northern Pulse Agronomy Project. Sites are expected to be co-located and managed.

All material from the COGGO alliance from WA has been transferred to PBA. The last set of transferred germplasm will be screened for AB resistance at Tamworth in 2013.

In order to broaden the germplasm being evaluated in Central Queensland (CQ) and to fast track the identification of an AB resistant line adapted to CQ, a set of breeding lines from the northern temperate region with early flowering and maturity will be evaluated in rows in CQ.
Faba bean

**Key Outcome 2016:** New faba bean varieties for cultivation in both the Mediterranean-type and Sub-tropical productions areas. These varieties will have greater yield than current varieties, will achieve minimum disease resistance standards, and will either meet the standard required for a premium product in the international food markets or be specifically targeted to the feed industry.

**Highlights 2012**

PBA Warda was launched in September 2012, in conjunction with Viterra (PBA faba bean commercial partner). PBA Warda is targeted to the northern NSW region and has higher yield potential and better quality seed than current northern varieties, assisting with improved marketability of faba beans produced in the northern region. PBA Warda is also resistant to rust and has yielded well in the presence of bean leaf roll virus (BLRV).

PBA Rana, launched in 2011, was grown commercially for the first time in 2012, with the majority of production for on-farm multiplication. However, 20 containers were exported to the Middle East and feedback on seed quality was very positive. PBA Rana is specifically suited to long-season environments, and the dry finish to the season resulted in lower yields than long-term averages in several areas such as the mid-north of SA. Nevertheless, PBA Rana still performed well in the areas it is most adapted and was higher yielding than the major varieties Farah and Nura at Millicent and the Southern Farming Systems site at Westmere.

Two new trials were added to the program, one at Rupanyup, Vic, to give better coverage of the northern Wimmera region, and an early generation trial at Pinery, SA, to increase selection for adaptation to low rainfall, short season conditions in the southern region. A screening system that enables simultaneous selection for resistance to cercospora leaf spot and ascochyta blight has been developed and implemented into the breeding program. This innovation should increase the rate of genetic improvement for resistance to both diseases.

Several new sources of disease resistance and diversity were incorporated in the breeding program in 2012 including resistance to rust; resistance to ascochyta blight and resistance to chocolate spot.

Crosses to elite breeding lines were made with the Imazapyr tolerant selections introduced (from SARDI project DAS00107) in 2011, further multiplication and crossing to elite material will occur in 2013.

Following adverse seasonal conditions that inhibited rust development at both PBI Narrabri and Tamworth Agricultural Institute no reliable results were obtained for rust resistance. Therefore all relevant lines were screened against rust at the Sydney University’s Plant Breeding Institute, Cobbitty in a recently developed seedling test in glasshouse chambers with the help of Emeritus Professor Bob McIntosh. At least three types of seedling reactions were identified; hyper-sensitivity, moderate level of resistance and susceptibility, indicating at least two genes were responsible for resistance. While field based screening methods are essential to get adult plant reaction the seedling test provided some results for the 2012 season.
Outlook 2013
A number of very promising breeding lines are progressing through the pipeline. Two southern region lines AF05069-2 and AF05095-1, both resistant to ascochyta blight and with very high yield potential across a wide range of sites will be considered for release in 2015 and 2016, respectively. A large seeded, high yielding and rust resistant line for the northern region (IX220D/2-5) with resistance to BLRV derived from Yunnan germplasm that was collected in 1996 during an Australia/ICARDA/China ACIAR project, is also progressing towards release.

Herbicide tolerant germplasm (imazapyr tolerance developed via mutation techniques, and naturally occurring metribuzin tolerant line) has been handed to the breeding program as an outcome of project DAS00107 and this material will be crossed and backcrossed with elite breeding lines and F2 populations screened for tolerance to the relevant herbicide in 2013, leading to the future release of imazapyr tolerance faba bean varieties.

Dr Jeff Paull (UA), PBA faba bean breeder addresses a field day
Field Pea

**Key Program Outcome 2016:** Increased productivity and profitability of the Australian field pea crop through the delivery of new varieties with improved yield and reliability of yield, crop management and grain quality.

**Highlights 2012**
PBA Pearl was launched in 2012. This variety offers a significant yield advantage for growers, it is broadly adapted to all field pea production regions, grows erect and is moderately resistant to bacterial blight. PBA Pearl produces high quality yellow peas which appear to be preferred for roasted snack foods in southern India. It is expected that this variety will initially only capture a small share of the current seed market, due to its specialised use in India. However, increasing international demand for yellow peas, particularly from China, could see its expansion in the future.

PBA Pearl joins the four other PBA field peas released since 2006. The two new bacterial blight resistant varieties PBA Oura and PBA Percy were available to growers in 2012, following their launch in 2011. They have already started to stabilise production across south eastern Australia where this disease has been seasonally devastating. Both varieties have good general adaptation to lower rainfall regions. PBA Oura has the added benefit of being an erect growing semi- dwarf type and having improved multiple pathovar resistance to downy mildew.

Superior germplasm has been identified from the 2012 evaluation for potential promotion to the field pea pipeline in 2013. The highest yielding germplasm yielded on average between 10-15% better than Kaspa or at least 5% better than PBA Pearl in stage 3 testing.

**Outlook 2013**
A number of varieties are scheduled for release in 2013. These varieties have specific regional targets and will assist with further stabilising field pea production.

PBA Wharton will be launched as a new high yielding Kaspa type variety. It performs well in short to medium growing regions and is resistant to powdery mildew and the viruses PSbMV and BLRV. PBA Wharton has improved tolerance to boron toxicity and improved grain quality for splitting. This line will be primarily marketed to Northern NSW and regional areas in the south that are prone to virus and mildew diseases. Potentially this variety may also capture some of the PBA Gunyah market share.

PBA Hayman is a new forage pea alternative to vetch, characterised by a multi-branched plant habit that grows erect and very tall, producing a large amount of biomass. The line has good bacterial blight tolerance and is resistant to powdery mildew making it suitable for a long growing season. This line produces small seed which reduces the cost of crop establishment and remains soft seeded in crop rotations.

PBA Coogee is a conventional dual purpose pea for lower rainfall regions which produces high dry matter early in the season that can be used for forage or left for grain (dun type) in longer growing seasons. This variety combines powdery mildew resistance and relatively high tolerance to both soil boron and salinity. These features allow PBA Coogee to more effectively utilise late season rainfall if left for grain compared to other dual type options (e.g. Morgan, Sturt or Parafield).
Selection in early generation lines will have a major focus on capturing improved lodging resistance, vigour and bacterial blight resistance and combining this with virus and mildew resistance, blackspot tolerance, boron tolerance, salinity tolerance and downy mildew tolerance. Breeding will also focus on pyramiding general yield potential.
Lentil

Key Program Outcome 2016: The productivity and profitability of lentils in Australia will be increased through the delivery of varieties with improved yield, stability of yield and quality, and which are cheaper and easier to grow and manage in rotations.

Highlights 2012
Two new PBA lentil varieties were released in 2012, bringing the PBA lentil stable to seven varieties in total. Both are higher yielding early to mid maturing red lentils that will expand production in lower rainfall regions.

One of the 2012 releases, PBA Ace® is the highest yielding lentil variety available and is suited to all lentil growing areas, especially longer season areas where Nugget has traditionally been grown. Its superior disease resistance makes PBA Ace® a better option than the other mid maturing varieties Nugget, PBA Jumbo®, PBA Bounty®, Aldinga and Northfield.

PBA Bolt® is an erect, early maturing red lentil with medium sized grey seed. It is best suited to growing regions similar to those of PBA Flash®, where early maturity, salinity tolerance and erect growth are keys to reliable and profitable production. PBA Bolt® has improved ascochyta blight resistance and higher yield in dry growing conditions compared to PBA Flash®. It is therefore better adapted to the southern Mallee, particularly where ascochyta blight is more of a risk.

In 2012 SARDI (DAS00107) screened a selection of lines from the PBA metribuzin and imidiazolinone lentil breeding populations. These were screened for metribuzin tolerance using cost effective and rapid screening methods devised by the project in the spring of 2012. Approximately 400 tolerant plants selected by the breeder were transported back to Horsham and grown through to seed.

Outlook 2013
CIPAL 1101 will be launched as a new variety in 2013. This higher yielding, more broadly adapted lentil incorporates the same imazethapyr herbicide tolerance as PBA Herald XT®. It also has high levels of disease resistance and should replace PBA Herald XT® in all areas and further expand production in dry areas.

Three other lines have also been identified for potential future release and will continue to progress through the pipeline in 2013:

- CIPAL0901 - large seeded, very early drought tolerant lentil for low rainfall non traditional lentil areas.
- CIPAL1001 - mid maturing lentil with the highest and most reliable yield of any lentil and good resistance to ascochyta blight and botrytis grey mould.
- CIPAL1207 - high yielding, disease resistant large green type with improved resistance to shattering, to replace Boomer® and expand green lentil production.

Germplasm with significantly higher yield potential than PBA Ace® has been identified from advanced testing in 2012. This germplasm will be promoted to NVT evaluation and breeder seed multiplication following review by the lentil breeding team in March 2013.
After leading the PBA Lentil Program since the inception of PBA in 2006, PBA Lentil Breeder, Dr Michael Materne left the program at the end of 2012. Dr Materne contributed to PBA not only as the lentil breeder, but also in assisting with the establishment of PBA - in particular in providing leadership in the development of the commercial partner pipeline arrangements and the end point royalty system for pulses, and in supporting and displaying the PBA ideal of best practice breeding. The current suite of PBA lentil varieties, PBA Ace<sup>®</sup>, PBA Bolt<sup>®</sup>, PBA Blitz<sup>®</sup>, PBA Bounty<sup>®</sup>, PBA Flash<sup>®</sup>, PBA Jumbo<sup>®</sup>, and PBA Herald XT<sup>®</sup> were developed under Dr Materne’s leadership.
Lupin

Key Program Outcome 2016: The release of improved varieties of narrow-leafed lupin to increase the profitability for farmers through higher yields and reduced input costs, and through increased suitability for premium paying markets in the aquaculture and food industries, thus increasing profits throughout the value chain.

Highlights 2012

Commercial quantities of seed for PBA Gunyidi® (released in 2011) were made available in 2012, and a reasonable quantity of this seed has been sold to growers for the 2013 season. The breeding program was pleased with PBA Gunyidi’s® yields and harvesting ability in 2011 NVT and on-farm trials. Even though it has not been released in eastern states there have been some growers requesting access to the variety.

In 2012 changes were made to the F4 trials, which resulted in better plant establishment, better seed production and allowed for single plant harvest to occur at a more convenient time when other technical activities are low. Numbers in the program’s 1st year yield testing were also increased by running 5m replicated plots rather than 10m partially replicated plots.

A number of lines from the wild/exotic crosses within the program were particularly impressive in 2nd year yield testing. These wider crosses, outside the core breeding program, are showing great potential with respect to agronomic variability and bode well for significant leaps in yield in the near future.

‘Drs Yang and Buirchell (DAFWA) discuss lentil markers for the breeding program’
**Outlook 2013**

In 2012 the line WALAN2325 was selected for launch in 2013 as a replacement for Tanjil. This line is approximately 12% higher yielding than Tanjil, has tolerance to metribuzin and should give growers in anthracnose infested areas an opportunity to generate greater income and better in crop weed control. WALAN2325 is also competitive for yield with Mandelup and will be released across Australia as its replacement. Pedigree seed in eastern states is not at the same level as WA, and its launch in the east will be delayed until 2014.

The DAFWA lupin gene map was interrogated for markers linked to anthracnose resistance in 2012. A number of markers were identified and the ones with the best validation added to a SNP array. A SNP array which now contains all the markers developed at DAFWA will be used for screening parents and F2 plants in 2013.

The new test will enable screening for a number of traits at the same time. Work towards developing new markers for CMV seed transmission resistance, Grey Spot resistance, QTLs for yield and environmentally induced alkaloid response to the environment (to help breed for low, stable seed alkaloid levels) will also continue. There will be further development of populations to phenotype these traits, and to identify and confirm suitable markers.

As part of a the PBA lupin program succession plan, a new lupin breeder Dr Jon Clements will join the PBA lupin breeding team at DAFWA in 2013.
PBA Strategy Reports

Strategy One
Target breeding of each PBA crop (chickpea, faba bean, field pea, lentil, and lupin) to specific production and likely expansion areas, based on crop adaptation to region and soil type.

The 2011 renegotiation of the PBA breeding programs saw a consolidation of the programs to more effectively breed for established growing areas for each of the crops; and a more specific focus on those areas into which the crops are most likely to successfully expand. The delivery of all PBA crop species varieties in all growing regions is unrealistic, however with targeted breeding PBA hopes to deliver robust varieties for the pulse crops best suited to regional growing conditions.

For example the PBA faba bean program will no longer run trials in Western Australia as it is considered that lupins, chickpeas and field peas will be better options in that region. Resources within the program have instead been refocused to expand core breeding and trial sites across the target southern and northern regions. A new site has been established at Cryon, near Walgett, in northern NSW to enable more extensive evaluation of breeding material under rainfed conditions in the region. There has also been an expansion of trials in the southern region with an S1 trial added to the program at Pinery, SA, to increase the selection pressure for performance under low rainfall, short growing season conditions.

The PBA desi and kabuli chickpea breeding programs have been consolidated to one site at NSW DPI, Tamworth. Prior to 2011 kabuli breeding had been conducted by DEPI Vic at Horsham. This has resulted in improved coordination of the breeding trials and efficiencies in breeding program operations.

Targeted breeding within the PBA lentil program is already paying dividends for Australian growers as demonstrated by PBA Flash®. While PBA Flash® is suited to all current lentil areas it is particularly suited to shorter-season (i.e. dryer) areas where its earlier maturity improves reliability of yield. Grower reports indicate that PBA Flash® has improved crop reliability in these areas considerably, with one grower indicating that PBA Flash® could be considered at least as reliable as wheat in his growing conditions, making it a viable and valuable part of his rotation.

Over the next five years targeted breeding will continue to deliver varieties which incorporate improvements of a number of key traits and which are better able to deliver consistent results in their target environments.

Strategy Two
Use reliable information on evolving production (growers) and market (end-users) needs to refine PBA breeding priorities.

The use of reliable information about the needs of both growers and the pulse markets will ensure that the PBA breeding programs are implementing breeding strategies to address the key production and quality traits required by the pulse industry. Industry engagement was pursued in a number of different forums in 2012.
The PBA commercial partners provide regular feedback on the performance of PBA varieties, both in terms of grower satisfaction and acceptance by the marketplace, to the PBA Release Advisory Groups (RAGs). Key issues raised by both industry and growers are also brought to the attention of the breeding programs via the RAGs. The proposed release of PBA Hayman®, a forage pea, in 2013 was in response to grower demand for better forage rotation options and reliable green/brown manuring crops.

PBA again participated in the Australian Grains Conference in 2012, presenting a display of advanced breeding lines and holding discussions about pulse quality requirements with both domestic and international pulse marketers.

Holding the regional PBA meetings at the NSW DPI’s Wagga Wagga Agricultural Research Institute in October 2012 provided an open forum for discussion. Growers displayed great interest in how to better produce and manage pulses and the role of pulses in the cropping systems of southern NSW. The day provided valuable feedback to the PBA breeders present about the traits needed to ensure pulses remain viable options in these farming systems.

**Strategy Three**

*Access technologies and germplasm to advance PBA breeding outcomes.*

PBA clearly articulates priorities for pre-breeding activities that are likely to contribute directly to the pursuit of the PBA vision. These priorities are reviewed by the PBA breeding programs on an annual basis, are available on the PBA webpage and are also disseminated via the PBA newsletter.

Through ongoing awareness of pre-breeding research activities and available enabling technologies, PBA is positioning itself for early and effective adoption of traits, germplasm and technologies that are likely to contribute directly to improving the PBA programs. Regular contact between the Pulse GE Coordinator, who sits on the PBA Coordination Group, and the PBA breeders, including an annual meeting between pre-breeding researchers and breeders, ensure PBA programs remain aware of relevant technologies and germplasm developments to improve future advances.

In 2012 the PBA faba bean program adopted a new screening system that enables simultaneous selection for resistance to cercospora leaf spot and ascochyta blight. A recently developed seedling test in glasshouse chambers at Cobbitty for rust resistance was also introduced. Both techniques delivering an increased efficiency in the faba bean disease screening program.

Both the faba bean and the lentil programs are introducing herbicide tolerant lines into the breeding programs as soon as they are made available from the relevant research projects. This early incorporation of new germplasm is already delivering for growers with the second herbicide tolerant lentil to be launched in 2013.

The PBA lupin breeding program continues to implement an effective molecular marker program, and in 2012 developed an SNP array containing all the lupin markers developed at DAFWA. The new technique will be used for screening parents and F2 plants in 2013, superseding the successful gel-based system used over the last 10 years.
Strategy Four
Optimise PBA breeding infrastructure and capability.

Ensuring PBA breeding programs have both up-to-date equipment and technologies and that PBA staff, both scientific and technical, have the appropriate training to optimise their roles will assist the programs to effectively deliver pulse varieties that contribute to the expansion of pulses in Australian cropping systems.

While each of the PBA breeding programs has varying infrastructure and capability needs, PBA is working towards building synergies across the breeding programs and ensuring that future capability is available meet pulse breeding needs. Adopting national on-line access to Agrobase for trial management and the integration of field based electronic data collection into the breeding programs have been recognised as a means to improve program efficiency.

Research capacity, both in terms of scientific and technical staff is also essential to the success of PBA. In 2010 the GRDC supported a PBA Capacity Building project for three years aimed at capturing new capacity for PBA and developing the existing skills/capacity of those within the PBA group for career development and possible succession planning.

In 2012 the PBA Research Capacity Project continued to support the PhD studies of Tony Leonforte, the PBA field pea breeder, DEPI Victoria, and Larn McMurray, a senior PBA agronomist with SARDI. The project also supported two honours students working on pulse projects at Charles Sturt University.

PBA technical staff must have a high level of competency to manage multiple pulse crops that often presents challenges beyond that of other crops. A PBA Technical Symposium has been held biannually since 2007. The symposium allows the technical staff from all PBA breeding programs located across the country to share experiences and skills. Building the professional relationships within this group will ensure ongoing interactions between PBA staff and the continuous improvement of PBA operations and outputs.

In 2012 the 3rd PBA technical symposium was held at Hermitage Research Facility, Warwick, Queensland – a key PBA chickpea research site. Representatives from each node of the breeding and agronomy programs attended and gave presentations. The presentations highlighted issues involved in servicing trial sites, equipment developed to ensure trial success and methods of disease inoculation, herbicide treatments and crossing techniques. Mr Brent Barlow a Research Specialist Professional from the University of Saskatchewan Canada attended as a special guest, giving a presentation on the pulse breeding program based at the University and an insight into the equipment and methodologies used in its breeding programs. A presentation on the latest bioinformatics packages (including field data capture and seed storage management) available to assist breeding was included in the symposium. The symposium also developed a program wide list of equipment and facilities considered essential for increased efficiency and accuracy in running trials based on technology readily available to growers.
Strategy Five
*Maintain PBA breeding activities at Best Practice.*

PBA breeding program strategies already reflect best practice breeding and in general the programs are operating at a level equivalent to the best pulse programs globally. Areas which may require further attention and/or resourcing into the future include: pre-breeding, molecular breeding, data management, the management of international relationships and ongoing training.

Following the development and articulation of clear areas of priority research for PBA a number of pre-breeding research projects addressing these priorities are now underway. Adequate future resourcing of the breeding programs to ensure implementation of the outputs of these projects is essential.

The majority of PBA breeding programs are on the cusp of using molecular markers for simple traits. However, in future access to high density fee-for-service genotyping by the breeding programs will be required to ensure that PBA’s transition to genomic selection and equivalent strategies is not limited. The successful implementation of genomic strategies into the PBA programs will require the management of large amounts of molecular data. Versatile data management systems which can link phenotypic data (stored in databases such as Agrobase) with molecular data will be essential to ensure real time plant breeding decisions can be made in any future breeding strategy.

Progressive breeding techniques, particularly in the areas of genomic selection and advanced data analysis & interpretation will continue to deliver improvements for the PBA breeding programs and it is essential that the PBA breeder’s skills in these areas are continually updated.

Access to genetic diversity is vital to the success of breeding programs. While the PBA programs have good international linkages access to new trait germplasm is becoming more restricted, particularly for those pulses not managed by the CGIAR centres. Consideration of jointly funded projects or acceptance of different IP conditions may need to be considered in future to ensure access to new germplasm.

Strategy Six
*Drive the maximum adoption of PBA varieties.*

Mechanisms to ensure the early adoption of PBA varieties are in place across the PBA breeding programs. Near release lines are included in NVT trials and key field day sites. This stimulates grower and advisor interest and familiarises people with the benefits of new varieties prior to their release.

All varieties are launched at key field days in the spring prior to their commercial release and growers are often able to order seed for the release season at the spring launches. Early bulk up of near to release lines ensures that adequate seed is available for growers in the release year.

Variety Management Brochures are developed for each new variety. Information on the variety’s key features, its yield and adaptation, and agronomic and disease management are detailed in the brochures, ensuring growers have the necessary information to make informed planting and management decisions.
A maximum adoption plan is developed by the commercial partner for review by the RAG’s for each new variety and uptake based on seed sales, and estimated areas sown mapped against predictions. Yearly RAG reports communicate adoption rates for each variety to the PBA Board.

**Strategy Seven**

*Improve the profile and influence of PBA in the Australian grains industry.*

Strategy 7 focuses on the three components of PBA - the PBA entity, its people and its products. Ensuring PBA is recognised as a world leading pulse breeding program (entity), that its researchers are acknowledged as world class with a proven track record of delivery (people), and that varieties are rapidly adopted and meet market requirements (products) will improve the profile and influence of PBA in the Australian grains industry.

PBA varieties and their accompanying brochures are strongly branded. All variety names begin with the prefix PBA. Variety brochures are developed to a standard format, and are instantly recognised as PBA. The success of recently released PBA varieties, such as PBA HatTrick®, are assisting in improving PBA’s profile.

PBA maintains a strong presence at field day launches of its varieties, and all trials of PBA varieties and late generation breeding material are signed as such. Variety launches and new varieties are publicised in the rural media via the PBA partner organisations and PBA commercial partners.

PBA researchers regularly attend regional field days and crop updates across Australia as well as participating in the Australian Grains Industry Conference, all opportunities to improve PBA’s Australian profile. Regular PBA researcher visits to overseas markets and research organisations, as well as participation in international conferences expose PBA to an international audience. This participation assures potential users of PBA varieties and potential researcher collaborators of the quality of both PBA products and the people developing them.

In 2012 PBA announced the PBA Inaugural Pulse Conference, to be held in 2013. This event will strongly promote and enhance PBA’s profile while strengthening pulse networks and collaborations across all sectors of the industry.

**Strategy Eight**

*Adopt a business approach to delivering breeding activities.*

In an environment of reducing public expenditure on research and development PBA is looking to maximise the efficiency of its operations by:

- increasing EPR collection to provide funds to underpin PBA activities and assist potential commercialisation of PBA.
- examining whether a transition of PBA breeding programs to the private sector may increase efficiency, reduce costs and potentially optimise delivery of new varieties to growers.
- examining if increased private sector investment in varietal development would enable existing state agency funds to be diverted to pre-breeding projects that target innovative productivity and quality traits for long term industry benefit.

In 2012 the PBA Board agreed to appoint a consultant to examine the issue outlined above, with a report and recommendation to be presented to the Board in late 2013.