

# Winter 2010

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**PBA**  
PULSE BREEDING AUSTRALIA

## PBA TREKS

### China Peas and Beans

Jeff Paull

The PBA faba bean and field pea breeding programs have enjoyed excellent and productive collaboration with the pulse breeding programs in China for many years. This continued in March with the participation of PBA members Brondwen MacLean (GRDC) and Jeff Paull (University of Adelaide) in a "Workshop on Genetic Improvement and Breeding of Cool Season Legume Crops", held in Kunming, China.



**China workshop participants: L-R Dr Fouad Maalouf (ICARDA), Jeff Paull, Prof Bao Shiyong (YAAS), Dr Clarice Coyne (USDA), Dr Ashutosh Sarker (ICARDA), Brondwen MacLean, Prof Zong Xuxiao (CAAS)**

The Chinese cool season legume research community meets four times per year and the theme for this particular meeting was international collaboration.

Other international participants were Dr Ashutosh Sarker and Dr Fouad Maalouf (both from ICARDA) and Dr Clarice Coyne (USDA Washington).

Prior to the workshop, the international visitors met in Beijing and travelled by high-speed train to Qingdao, the site of the Olympic yachting events. It is also the location of Qingdao Academy of Agricultural Sciences which has many fruit and vegetable breeding programs. A large cold-tolerance nursery for Chinese accessions of faba beans (4100 entries) and field peas (3700 entries) was conducted in 2009/10 with temperatures below  $-10^{\circ}\text{C}$  for extended periods in winter when plants were at the early vegetative stage. The majority of entries of both crops were killed by the low temperatures, but a few lines survived and will be retested in 2010/11.

The workshop consisted of field trips and one day of presentations. All of the international participants and a number of senior Chinese delegates presented overviews of their areas of research and expertise and this provided a background for future discussions during the workshop. Areas of common interest with Australia included water use efficiency/drought tolerance, temperature stress (both high and low), disease resistance and development and implementation of molecular markers.

On the field trips we visited a number of locations, and the common factor in all areas visited was the impact of the 1 in 100 year drought gripping South Western China. Many dryland crops looked similar to crops in southern Australia in 2006, and water was in limited supply for irrigated crops.

Cultural highlights included a visit to the historical city of Dali in the west of Yunnan, food, a visit to the Minorities Village Park (there are 26 minority groups in Yunnan and buildings representative of each group are in the Park), food, the Stone Forest and more food.

The scientific linkages between China and Australia will be continued through development of research projects and scientific exchanges. Ms Li Ling from the Liaoning Institute of Cash Crops, Liaoning Academy of Agricultural Sciences, has been awarded a GRDC supported Vavilov-Frankel Fellowship and will spend 10 months with Dr Bob Redden at ATFCC, commencing in late September, to provide climatic and soil data on the collections sites for the pea core collection from China, plus locations where germplasm was collected in the recently completed ACIAR project. In addition, Mr He from Yunnan Academy of Agricultural Sciences is applying to spend 6 months with the faba bean breeding program in Adelaide.

# PBA VARIETY LAUNCHES 2010

PBA is launching two new lentil and two new field pea varieties over the spring. The varieties will be available from PBA commercial partners, AWB Seeds for field peas and PB Seeds for lentils, for planting in the 2011 season.

## Lentils

### ***CIPAL 610***

This red lentil is suited to all current lentil areas. It is particularly suited to shorter-season areas where its combination of mid to early flowering, early maturity, high yield, and good disease resistance will improve lentil reliability and economics of production. CIPAL610 is the earliest maturing lentil variety and the best option where crop topping and/or delayed sowing are practised. CIPAL610 has improved early vigour over all other red lentils varieties and an erect plant type. It is well suited to no-till and inter-row sowing into standing residue. The seed of CIPAL610 is slightly rounder and significantly larger than Nugget<sup>®</sup> with improved milling characteristics over this variety also.

### ***CIPAL605***

CIPAL605 is the highest yielding large seeded red lentil. It is suited to most current lentil growing areas where it has consistently yielded around 15% higher than Aldinga. Botrytis grey mould (BGM) will need to be managed on this variety in high rainfall areas. CIPAL605 is well suited to no-till, inter-row sowing into standing residue. It has a seed size and shape similar to Aldinga (20% larger than Nugget<sup>®</sup>) with a grey seed coat. Milling quality is better than Nugget<sup>®</sup> and it is well suited to premium large red split markets such as those in Sri Lanka.

Regional field day launch dates for the new lentil variety will be released soon. However, there will be a metropolitan launch at the Adelaide Royal Show on Friday 3 September – if you are attending the show come along to the Golden Grain Pavillion at 10.45am for the launch by the South Australian Minister for Agriculture Food and Fisheries.

## Field Peas

### *PBA Gunyah<sup>Ⓛ</sup> and PBA Twilight<sup>Ⓛ</sup>*

PBA Gunyah<sup>Ⓛ</sup> and PBA Twilight<sup>Ⓛ</sup> will provide the same agronomic benefits of the variety Kaska<sup>Ⓛ</sup> in relation to lodging and pod shatter resistance at harvest, but are both much earlier flowering, have significantly higher grain yield and will be more reliable in low to medium rainfall environments.

PBA Gunyah<sup>Ⓛ</sup> has a longer flowering duration than PBA Twilight<sup>Ⓛ</sup> and will be better suited to longer growing seasons. PBA Twilight<sup>Ⓛ</sup> is relatively earlier flowering and will be better suited to shorter growing season climates.

Growers in low rainfall regions have the option of growing both PBA Gunyah<sup>Ⓛ</sup> and PBA Twilight<sup>Ⓛ</sup> to manage the risk of low seasonal rainfall or paddock variability and still market grain from either variety as 'Kaska type'. Both varieties are better suited than Kaska<sup>Ⓛ</sup> to the practices of delayed sowing for disease management and crop topping to control annual ryegrass.

Field Pea launch dates have been determined as follows:

Thursday 9 September	Birchip Cropping Group Field Day, Birchip, Victoria
Tuesday 14 September	DAFWA Salmon Gums Field Day(north of Esperance) - in association with the Pulse Association of South East (PASE), WA
Tuesday 21 September	Hart Field Day, Hart SA
Friday 8 October	Central West Farming Systems (CWFS) Rankin Springs Regional Site Field Day, NSW



*Above: PBA Gunyah<sup>Ⓛ</sup> and below PBA Twilight<sup>Ⓛ</sup>*



## PBA BOARD NEWS

### Board Chair

The PBA Board farewelled inaugural PBA Board Chair, Peter Reading (GRDC) in March. Thank you to Peter for all the time, effort and enthusiasm he invested into developing PBA into a recognised national pulse breeding program. As Chair Peter fostered an inclusive and cooperative culture at the Board level, which has permeated throughout PBA. The new PBA Chair is Mark Sweetingham. Mark is a PBA Board member and Director of Grains Industries Development at the Department of Agriculture and Food, Western Australia. Mark and all the PBA Board members are looking forward to successfully guiding PBA into its second phase as it builds stronger linkages and collaborations to ensure the future delivery of better pulse varieties to Australian growers.

### University of Adelaide

Prof Roger Leigh resigned from the PBA Board in February and is replaced by Prof Diane Mather, University of Adelaide. Dianne has experience in plant breeding, genetics and molecular marker technologies and is a welcome addition to the PBA Board. Thank you to Roger for his able representation of the University of Adelaide and his contribution to the development of PBA. We wish Roger every success in his newest endeavour as Director of the Waite Research Institute at the University of Adelaide.

## NEW PULSE PROJECTS

### Development of Herbicide Tolerant Pulses

Larn McMurray

SARDI in collaboration with the University of Adelaide has commenced work on the PBA initiated and GRDC funded project *Development of herbicide tolerant pulses*. This three year project started on March 1 2010 and is expected to increase the yield, production and area of pulses in Australia through:

- broadening the range of herbicide options available in faba bean and lentil,
- identification of pea, chickpea, lentil and faba bean lines with higher levels of tolerance to selected registered herbicides,
- development of pulses with multiple herbicide tolerances.

Dili Mao has recently been appointed to the position of Research Officer. Dili, along with Larn McMurray, Klaus Oldach and Phil Davies (SARDI) and Jeff Paull and Chris Preston (UA), form the project team. Dili has a degree in Agricultural Science from the University of Sydney and last year completed an honours project in chickpeas with Ted Knights at Tamworth - so comes to the project well trained and highly recommended! The project will have strong linkages and communication with PBA and the delivery of simple and efficient herbicide tolerance screening techniques to the breeding programs is a key output. Work has begun in Australia with the development of mutagenised populations lentil and faba bean. These were both sown in South Australian field trials in May.

The project will also develop links with Prof Bert Vandenberg and other researchers at the Crop Development Centre, University of Saskatchewan, who are currently instigating similar research projects. An initial meeting was held recently with Prof Vandenberg in Turkey at the IFLRC to discuss collaborative opportunities and research ideas.

Please contact Dili Mao – [dili.mao@sa.gov.au](mailto:dili.mao@sa.gov.au) or Larn McMurray [larn.mcmurray@sa.gov.au](mailto:larn.mcmurray@sa.gov.au) for further information.

## Molecular markers for pulse breeding

**Sukhjiwan Kaur, Noel Cogan, John Forster, Kristy Hobson, Tony Leonforte, Michael Materne (DPI Vic), Jeffrey Paull (University of Adelaide)**

The Victorian Department of Primary Industries, in collaboration with the University of Adelaide (UA) has commenced work on the GRDC-funded project *Molecular markers for pulse breeding*. The project team includes molecular geneticists from DPI-Bundoora and breeders from DPI-Horsham and UA. This three year project started on July 1, 2009 and aims to develop and deliver molecular genetic markers for Pulse Breeding Australia (PBA) through:

- Sequencing the transcriptomes (expressed gene complement) of lentil, chickpea, field pea and faba bean for identification of molecular variation between individuals (polymorphisms)
- Identification and tagging of chromosomal regions involved in disease and environmental stress tolerances and other important agronomic traits
- Application of molecular genetic markers linked to agronomically important genes for breeding applications.

The project has made very significant progress in the first year. Using the high-throughput 454 GS-FLX Titanium sequencing technology, transcriptome sequencing has been performed for six genotypes of lentil (Northfield, ILL6788, Digger, Indianhead, ILL7537, ILL2024), four genotypes of chickpea (S95362, ICC3996, Lassetter, Howzat<sup>(b)</sup>), four of field pea (Parrfield, Yarrum<sup>(b)</sup>, Kaspas<sup>(b)</sup>, 96-286) and two genotypes of faba bean (Icarus, Ascot). A total of 1.4 million ESTs (expressed sequence tags, corresponding to regions of the genome which are turned into RNA coding for proteins) have been generated for each of lentil and chickpea, c. 700,000 for field pea and c. 300,000 for faba bean. The majority of the genes for each crop species have been identified and annotated. The EST database will be used to design single nucleotide polymorphic (SNP) and simple sequence repeat (SSR) markers.

SNPs are a genetic marker system that can differentiate individuals based on variations detected at the level of a single nucleotide base (one DNA sub-structure unit) in the genome. Such variations are present in large abundance in the genomes of all higher organisms, including plants. Due to advancement of sequencing technologies and the development of high-throughput SNP assay technologies, it is anticipated that SNPs markers will play an increasingly important role in genetics and breeding applications, as they can be placed close to any target gene in the genome.

These molecular markers will then be assigned to genetic linkage maps for each species. A large number of mapping populations will be assessed for disease resistance, tolerance to environmental stresses (such as salinity and boron toxicity) and important agronomic traits. Finally, a quantitative trait analysis will be performed in order to identify linked markers suitable for selection of the traits of interest.

The project will also develop links with Prof. Bert Vandenberg and other researchers at the Crop Development Centre, University of Saskatchewan, who are currently working on similar research projects. An initial meeting was held recently with Prof. Vandenberg and his colleagues in Turkey at the IFLRC to discuss collaborative opportunities and research ideas.

Please contact Michael Materne – [michael.materne@dpi.vic.gov.au](mailto:michael.materne@dpi.vic.gov.au) or John Forster – [john.forster@dpi.vic.gov.au](mailto:john.forster@dpi.vic.gov.au) for further information.

## Improving yield and reliability of field peas under water deficit

**A/Prof. Victor Sadras (SARDI)**

Improved adaptation to water deficit can be achieved directly, by breeding and selection in target environments, indirectly, by targeting secondary traits related to improved performance in stressful environments, or more often by combining direct and indirect approaches.

Using field peas as a model crop, the aim of this GRDC supported project is to identify secondary traits that will, in combination with breeding and selection, contribute to adaptation to water deficit.

The project team includes crop physiologists, agronomists and breeders from SARDI, the University of Adelaide and Victoria DPI. Lachlan Lake has been appointed as Senior Research Officer, and will run the field trials.

The project began in May 2010 and this season the team are assessing a collection of 30 field pea accessions in five contrasting environments. With the critical input of PBA Field Pea breeder Tony Leonforte, this collection has been assembled to reflect contrasting yield performance under drought as evaluated in previous seasons, and to cover the whole range of phenological development.

Three sets of traits are being evaluated:

- phenological development,
- canopy function, and
- yield components.

Using visual observations aided with digital photography we will characterise phenology per se – average date of key phenostages (flowering, pod set, onset of seed growth, maturity), spread of phenology, i.e. the frequency distribution of individuals in the population, and plasticity of phenology using both Finlay-Wilkinson and Réale-Dingemans methods.

Canopy function will be assessed using thermal images. This is a typical integrative trait, as it reflects root (e.g. access to deep water) and leaf (e.g. stomatal sensitivity) traits.

Standard evaluation of yield components will be complemented with estimates of crop growth rate in the critical window of yield determination between the beginning of flowering to the beginning of seed fill for the last seed-bearing phytomer.

While the project is using field peas as a model crop it is envisaged that in the future results will be translated into the other PBA crops and assist with the development of pulses better adapted to the often dry conditions of Australia's cropping regions.

## PULSE RESEARCH FINDINGS

### Improved yield in PBA field peas in southern Australia due to research advances in agronomy and pathology

Larn McMurray, Jenny Davidson,  
Michael Lines (SARDI), Tony Leonforte  
(DPI Vic), Moin Salam (DAFWA)

Field peas are a major pulse crop grown across southern Australia. Delayed sowing by 4-6 weeks after the season break has conventionally been recommended to minimise yield losses from the major foliar disease of field peas - ascochyta blight (synonym: blackspot). However, drier and hotter springs in recent seasons have resulted in greater yield penalties from delayed sowing than from this disease. These shorter growing seasons have also rapidly shifted the selection intensity in PBA field pea breeding towards genotypes with earlier flowering.



*Field pea agronomic trial, Hart SA 2009. Photo by Jenny Davidson.*

Research led by SARDI incorporating these earlier flowering genotypes, and funded by the South Australian Grains Industry Trust (SAGIT) with additional funding from GRDC, was conducted to identify optimal management strategies that reduce losses from both disease and delayed sowing.

Experiments were conducted at three sites in SA from 2007-2009 involving:

- differing sowing dates - conventional, and 2-3 and 4-6 weeks earlier,
- various genotypes - including Alma (tall trailing type), Kaspas<sup>®</sup> (semi-leafless erect) and the PBA breeding line OZP0602, to be named PBA Gunyah (earlier flowering, semi-leafless), and
- six fungicide treatments - combinations of P-Pickel T<sup>®</sup> seed dressing and mancozeb foliar fungicide.

Ascochyta blight infection occurred in all years irrespective of treatment and location, but only reduced grain yield in one experiment in 2008 and two in 2009. When disease did not influence yield, earlier sowing was generally higher yielding than the later conventional sowing date for all varieties and lines. However, when disease pressure was severe the yield loss was as high as 35 % in the earliest sowing dates. Varieties differed in yield response to sowing date and in levels of disease infection (OZP0602 had lower disease levels than all other genotypes), although these small improvements in resistance did not translate to a yield advantage in these experiments. The combination of seed treatment and strategic foliar

fungicides gave a positive yield response in 2009, but this was variable between sowing dates and varieties.

Under current weather patterns of lower rainfall and shorter growing seasons, this study suggested the optimum planting period is within a week of the first autumn rains in low rainfall regions and 3 weeks after the first autumn rains in medium and medium - high rainfall regions of southern Australia. Additional grain yield can be achieved in these conditions by using improved earlier flowering genotypes (such as OZP0602). These earlier flowering genotypes were also found to have a broader adaptation to a range of sowing dates which will give growers the flexibility to either sow earlier using current disease management strategies or sow later if the predicted disease risk is high *via* disease forecasting models such as "Blackspot Manager" (developed by DAFWA). Fungicides with greater efficacy than mancozeb are still required to maximise yield at the earliest sowing time and this research is ongoing.

*Funding for this research was kindly provided by the South Australian Grains Industry Trust (SAGIT) and GRDC. The technical staff at SARDI Clare, and SARDI Pulse pathology are also thanked for their field and technical assistance and expertise.*

## Measuring the impact of bacterial blight (*Pseudomonas syringae* pv. *syringae*) on production of Australian field pea varieties

Eric Armstrong Kurt Lindbeck, N. Coombes, Gerard O'Connor, Peter Matthews, Luke Gaynor (I&NSW), Helen Richardson (DPI Vic)

Bacterial blight occurs sporadically in field pea crops across southern Australia. Its highly unpredictable occurrence combined with an unpredictable affect on yield makes it a difficult disease to manage, particularly as control options are limited, expensive and often cosmetic. Variety resistance offers a good alternative for its management under these circumstances. Currently however, there is little or no information on susceptibility of Australian field pea

varieties or breeding lines and the associated yield penalties due to bacterial blight infection.

There are two major pathogens of bacterial blight present in Australia - *Pseudomonas syringae* pv. *psidi* and *Pseudomonas syringae* pv. *syringae*. While *P. syringae* pv. *psidi* is considered the most important and economically damaging of the two on a global scale, over recent times *P. syringae* pv. *syringae* appears to be more damaging under southern Australian conditions.

A series of field experiments were conducted from 2006 to 2009 at Wagga Wagga in southern NSW to measure production losses in field



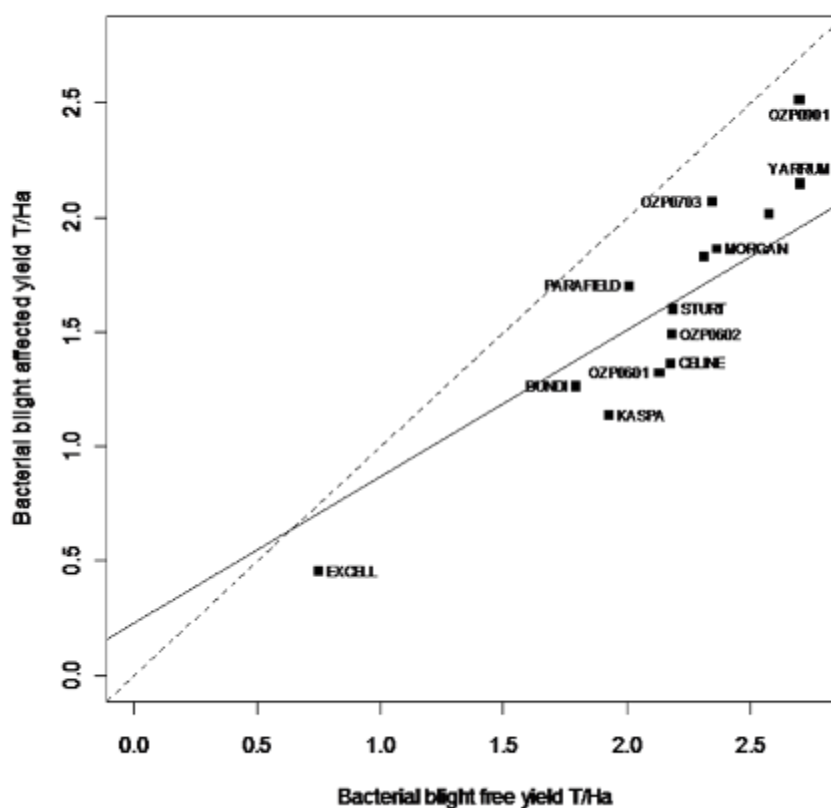
*Eric Armstrong with the field trials*

pea resulting from artificially created epidemics of bacterial blight (caused by *Pseudomonas syringae* pv. *syringae*). Randomised blocks of infected and disease-free areas of bacterial blight were established over 4 seasons (2006-09) in a border-check irrigation system. Planting material was sourced from current commercial field pea varieties and advanced breeding lines from the PBA Field Pea Breeding Program.

The site was pre-irrigated each year to enable early sowing (15-30 May) and specifically selected for flat topography and low altitude relative to the surrounding to encourage frost damage which pre-disposes the plants to infection by the bacteria. The organism had been previously collected from locally infected crops and stored under laboratory conditions. Samples were subsequently cultured and multiplied then sprayed onto coarsely chopped pea straw as a liquid broth. This was spread by hand across the plots when plants were at the 2-4 node stage (2-3 weeks after emergence). After spreading, plots were mechanically damaged to further assist entry and infection by the bacteria. In all years, severe epidemics developed from mid August onwards. Subsequent growth and development of the plots was observed and yield taken at maturity using a small plot harvester.

All varieties developed scattered bacterial blight symptoms during early growth (4-8 nodes, around July) but came under heavy disease pressure from around mid August onwards when the disease developed into epidemic proportions across the infected blocks. However, each year the disease halted from around mid September onwards, and at that time, differential responses between varieties were clearly apparent. From this point onwards, the more resistant varieties tended to grow away from the disease to become almost symptom-free, while the most susceptible were slow to recover, if at all.

Bacterial blight reduced yields on average by around 25%, however there were large differential responses between varieties. Figure 1 shows bacterial blight-free yield plotted against bacterial blight-affected yield and highlights the relative ranking of the varieties and breeding lines. The highest yielding and most resistant varieties are to be found above the regression line and to the upper right portion of the graph. Hence, OZP0901, OZP0703, Yarrum<sup>db</sup> and Morgan<sup>db</sup> stand out and group together as the best varieties, while Excell performed very poorly in these trials followed by Kaspas<sup>db</sup>.



**Figure 1. Bacterial blight-free yield plotted against bacterial blight-affected yield. The solid line regresses the linear relationship between these two yields. The dotted line represents a 1:1 relationship where disease would have no effect.**

OZP0901 was identified as being one of the highest yielding varieties and the least affected by bacterial blight, and on this basis was classified as resistant (R). The next group of varieties were either moderately resistant (MR) or moderately resistant/ moderately susceptible (MR/MS) and included OZP0703, Yarrum<sup>db</sup>, Parafield and Morgan<sup>db</sup>. Kaska<sup>db</sup> was one of the most susceptible varieties evaluated.

Bacterial blight appears sporadically in field pea in the Australian environment but can have devastating impacts on both production and grower confidence. These results not only provide a measure of production losses from the disease, but also provide excellent prospects for the future development of resistant field pea varieties in Australia. To this end, two of the most resistant breeding lines OZP0901 (classified as resistant) and OZP0703 (classified as moderately resistant) are currently being seed increased for potential release as bacterial blight resistant varieties in 2012.

## A new herbicide option for chickpea: Metribuzin as a post emergent

Ping Si, CLIMA

Weed control in grain legumes has been an important issue in Australia. Herbicides have been the most effective method in controlling weeds and allow the practice of minimum tillage farming systems for the conservation of soil moisture and prevention of soil erosion. The lack of herbicide tolerance in grain legumes has limited their sowing areas and production. Therefore, improving herbicide tolerance in grain legumes is very important.

Currently, there are very limited options for post-emergent herbicides in chickpea, making weed control very difficult. Broad-strike®, a Group B herbicide, can be used in chickpea for post-emergent application, but quite often it causes crop damage and weed control is inadequate. The evolution of Group B resistant weeds reduced efficacy of this herbicide further. There are pre-emergent herbicides available for chickpea. These herbicides act at sowing and at very early stage seedling growth. However, as chickpea has slow early growth, weeds germinated after crop emergence often become dominant and as a result, the chickpea crop suffer several yield loss. Having a good post-emergent herbicide and chickpea cultivars with improved herbicide tolerance would ensure its seed yield and its place as a valuable rotational crop in Australian dryland farming systems.



**Chickpea tolerance to metribuzin post-emergent at 200 g/ha. L to R: one tolerant and three susceptible chickpea cultivars**

Metribuzin is a versatile herbicide, and has been used either pre-emergent or pos-emergent in various crops for many years. It controls wild radish and other broad-leaf weeds when

applied post-emergent. When applied pre-emergent, it retards grass weeds growth. Metribuzin is registered in chickpea to use only as pre-emergent, but safe as post-emergent in narrow-leafed lupin. It can also control the weeds resistant to Group B herbicides which are widespread in many cropping areas. Among the weeds which developed resistance to common herbicides, fewer weeds were found to be resistant to metribuzin.

Recent research conducted at CLIMA found that two chickpea accessions were tolerant to metribuzin post-emergent at a rate similar to that used in narrow-leafed lupin (see photo). While all current chickpea cultivars were susceptible to the same rate of metribuzin applied post-emergent, finding tolerance in the accessions provides a promise that metribuzin can be used as a post-emergent herbicide to selectively control common broad-leaf weeds in future chickpea crops.

The two tolerant accessions of chickpea were identified after screening 100 germplasm accessions with a diverse genetic and geographic background from across the world. Nature has evolved some herbicide tolerance in chickpea. Luckily, these two tolerant accessions also have good agronomic characteristics. They provide the foundation for developing chickpea cultivars tolerant to metribuzin post-emergent so that this herbicide can be used safely in chickpea. The project is collaborating with the PBA chickpea breeding program to make good use of the metribuzin tolerant chickpeas.

Germplasm screening is part of the continued endeavour, funded by GRDC (UWA 121), to improve herbicide tolerance in pulse crops of chickpea, field pea and lupin. This breakthrough has been a team effort involving Dr Ping Si (CLIMA), Drs Yinglong Chen and Shyama Weerakoon (CLIMA), Profs William Erskine (CLIMA) and Steve Powles (WAHRI) together with the PBA Chickpea Breeding Program, who supplied the germplasm.

## Pea seed borne mosaic virus staining of faba bean seed

Rohan Kimber, Michelle Russ and Jeff Paull

The faba bean breeding trials at Turretfield were grown in a paddock cropped with field peas (Kaspa<sup>®</sup> and Maki). The trials were very uniform, high yielding (average yield of the S3 trial was approx 4t/ha) and little fungal disease apart from some *Ascochyta* blight on the more susceptible lines. When cleaning seed post-harvest, Kevin James observed significant symptoms indicative of Pea Seed borne Mosaic Virus (PSbMV) on several multiplications, while one line was virtually symptom-free. This chance infection, and initial indication of genetic variation in level of seed staining, provided the opportunity to carefully examine the degree of variation in expression of symptoms of PSbMV in the major varieties and advanced breeding lines.



*Symptoms of Pea Seedborne Mosaic Virus on Nura<sup>®</sup>*

Individual plots of approximately 30 lines were sampled (100 seeds/plot) and individual seeds in each sample were assessed for degree of symptoms of PSbMV on a 4 point scale where 0 = no symptoms, 1 = minor, 2 = moderate and 3 = severe symptoms (see photo).

An index of seed staining for each sample was calculated to take into account the number of seeds within each category.

There was a high level of variation between the lines tested, including a number of breeding lines with very few seeds displaying either moderate or severe symptoms of PSbMV (Table 1). All varieties tested had a moderate to high level of symptomatic seeds, and in particular Nura<sup>(b)</sup> and Manafest were badly affected. The breeding line AF01006-1, which is targeted for release in 2011, is the result of a single backcross to Manafest as the recurrent parent. However, in contrast to Manafest, very few seeds of AF01006-1 expressed symptoms of PSbMV.

**Table 1. PSbMV seed staining of faba bean lines at Turretfield in 2009.**

Line	Seed staining				Index
	0	1	2	3	
Doza	55	15	21	9	28
Farah	51	27	17	5	26
Fiesta VF	65	18	14	4	19
Fiord	67	19	10	4	17
Manafest	23	34	34	9	43
Nura	31	28	31	11	41
AF01006-1	82	15	3	0	7
AF03001	85	10	5	1	7
AF03063	56	18	21	6	25
AF04053	89	10	1	0	4
AF04064	16	25	47	13	52
AF05023	75	19	7	0	11
AF05069	53	19	25	4	27
AF05095	32	30	34	5	37
AF06084	86	13	2	0	6
AF06104	38	24	36	3	35
AF06125	81	14	5	0	8

Seed staining: 0 = no staining, 3 = severe staining

Index:  $[(nx0)+(nx1)+(nx2)+(nx3)]/3$ . Min value = 0, max value = 100. Values are the mean of 4 reps.

Several points arise from this study:

1. Plants were not tested for virus infection, so it is not known if the variation seen in symptom expression on seeds reflects variation in plant resistance.
2. The trial at Turretfield was sown with seed from the same source as that used to sow a trial at Charlick. There were virtually no symptoms of PSbMV on seed from the Charlick trial which indicates that the symptoms at Turretfield resulted from infection of the crop and were not introduced by infected seed.
3. It is not possible to determine the effect of PSbMV on yield in this trial, however a simple correlation between yield and PSbMV index was not significant.
4. Australia Pulse Trading Standards allow for 3% poor colour seed, including disease stained seed. The high level of severely stained seed of some lines in this study indicates that these lines could be at risk of not achieving the receival standards in the event of an infection by PSbMV.

# UPCOMING EVENTS

## PBA Phase II Planning

The PBA Board and Coordination Group will be meeting on 7 and 8 September in Perth to plan for PBA Phase II. The current PBA Participation Agreement, along with current GRDC funding arrangements for the PBA projects (with the exception of the Lupin Breeding Program) expires in June 2011. All PBA Partners have agreed that PBA should be continued for a further 5 year period and the September meetings will facilitate a smooth transition to the second phase of PBA. The Board and Coordination Group will hold a joint meeting on 7 September to set the direction of PBA Phase II. Issues to be discussed include PBA core activities, managing and progressing relationships (nationally and internationally) and revising the PBA National Plan. On 8 September the Coordination Group will discuss operational plans for the PBA programs. Topics to be covered include; potential efficiency improvements; linkages with national pulse projects external to PBA; and international collaborations.

# PBA PROGRAM UPDATES

## Chickpeas

Ted Knights

### *New varieties*

2010 saw the first commercial plantings of PBA's initial chickpea varieties, PBA HatTrick<sup>®</sup> for the north-east and PBA Slasher<sup>®</sup> for the south and west. Grower response has been keen, especially for PBA HatTrick<sup>®</sup> for which much larger seed volumes were available. The estimated PBA HatTrick<sup>®</sup> area in northern NSW and southern Qld is between 80,000 and 100,000 ha.

Seed increase of the Central Qld variety PBA Pistol<sup>®</sup> is on target for a 2012 release. The reversion of this region to a more typical (i.e. harsher) year in 2009 highlighted the great yield advantage this variety promises. Col Douglas and Jon Thelander (AWB Seeds) recently spent two very productive days in Central Queensland checking progress of PBA Pistol<sup>®</sup> seed increases and flying the PBA flag. They caught up with Ian Buss and Gail Dowie, Galleon Grains (AWB Seed, SeedNet partners) who are increasing PBA Pistol<sup>®</sup> on Baamba Plains at Springsure. The group also visited PBA Pistol<sup>®</sup> seed increases on Colin Downs, Clermont owned by Colin Cattell.



*Left: Ian Buss, Col Douglas and Gail Dowie at the mailbox of Col's new chickpea empire.  
Below: Col and Ian inspect PBA Pistol<sup>®</sup> on Colin Downs, Clermont (photos: Jon Thelander)*



Meetings of the Release Advisory Groups (Desi and Kabuli) earlier this year recommended the continued bulk-up or handover to the commercial partner of a range of Ascochyta resistant lines. The desi lines CICA0511 (north) and CICA0603, CICA0604 and CICA0717 (south/west) are now with AWB Seeds. Precious seed of CICA0857, a medium-large seeded, Ascochyta resistant kabuli is also now with AWB Seeds, having been eked out of a run of horror years in Victoria. This variety should have a promising future in the south, but NVT results in northern NSW also indicate a potential there.

### ***What's in a name?***

For those wondering about the CICA prefix for all NVT chickpea entries: it stands for 'Co-ordinated Improvement of Chickpea in Australia'. It is pronounced the same way as 'Cicer', the generic name for chickpea. The name 'Cicer' stems from the Roman emperor Cicero who was reputed to have loved his chickpeas.

### ***2010 – a 'make or break' year in NSW?***

There has been a 50% increase in chickpea area in NSW this year. District Agronomist estimates are for 340,000 ha, most being in the northern third of the state where chickpeas account for nearly 20% of winter crop area - in some districts, such as Moree, the figure is 30%. These figures imply that most farmers now have chickpea in their rotations. They also highlight the increased inoculum load for the two main regional diseases Ascochyta blight and Phytophthora root rot. This was confirmed in a recent road trip by Kevin Moore who found serious Ascochyta development in two crops where susceptible varieties are being used. (A previous survey had, more encouragingly, found Ascochyta in only one of seventy crops inspected, possibly a reflection of better management and a swing to more resistant varieties).

### ***New (and not so new) breeder***

Dr Kristy Hobson, currently kabuli chickpea breeder with DPI Vic, Horsham has accepted a position with I&I NSW at Tamworth and will take over the PBA Chickpea Breeding Program from Ted Knights when he retires, most likely sometime in July 2011. Despite her tender years Kristy brings with her a wealth of experience in chickpea breeding and a great work ethic characteristic of the Horsham team. Kristy is likely to make the move to Tamworth in March 2011 and is reportedly looking forward to milder winters, but not the cultural wasteland of rugby league.

## **Field peas**

**Tony Leonforte**

The focus of the PBA field pea breeding program is to improve yield reliability for the lower rainfall cropping zone. Direct selection for grain yield in lower rainfall regions is continuing to identify superior germplasm with broader adaptation and higher yield potential (e.g. OZP0903). In addition ongoing years of below average rainfall have increased selection pressure for water use efficiency and drought tolerance *per se*.

An interesting observation made in 2009 was the range in foliar resistance to high ascochyta blight disease pressure in SA breeding nurseries. Except for the most extremely susceptible lines which died, the level of foliar symptoms did not appear to be closely associated with final grain yield, which was surprising. Also lines with significantly and consistently higher tolerance (e.g. final grain yield) were identified from highly diseased sites (i.e. OZP1001) in SA. This indicates high potential to improve tolerance to ascochyta blight via direct selection for grain yield.

In 2011 two new higher yielding Kaspas<sup>Ⓛ</sup> type lines OZP0601 and OZP0602 (will be named at variety launches in 2010) will be released for the low rainfall zone. Both lines flower early and are more broadly adapted than Kaspas<sup>Ⓛ</sup> and Parafield. Specifically OZP0601 is better adapted to shorter growing seasons, but OZP0602 has relatively broader adaptation extending into medium rainfall regions.

New dun type lines with superior bacterial blight resistance (e.g. OZP0703) have also been identified from the PBA program. These are being fast tracked for release to growers by 2012. Bacterial blight is caused by two pathovars of *Psuedomonas syringae* for which there is differential resistance that the PBA program is attempting to combine.

The next phase of variety releases from the PBA field pea breeding program is on target to release superior Kaspas<sup>Ⓛ</sup> type lines that combine high disease resistance to the viruses BLRV and PSbMV and fungal pathogens powdery mildew and downy mildew as well as higher tolerance to sub-soil boron toxicity (e.g. OZP0805). In addition a pure forage pea (OZP0902) has also been identified as a potential release as an alternative to vetch.

PBA research also aims to make longer term genetic gains by attempting to identify high abiotic stress tolerance to frost, heat and soil salinity and high disease resistance to ascochyta blight. In all cases exciting discoveries have already been made. However there is now the challenge of transferring these traits from un-adapted plant backgrounds into new varieties for growers.

**Table 1: Mean yield from 2005-2009 for OZP lines and commercial varieties relative to Kaspas<sup>ϕ</sup> (from Stage 3 and NVT field pea yield nurseries) across southern Australia.**

Kaspas yield potential Experiment No KASPA t/ha	2005-2009 MEAN	2005-2009 MEAN	2005-2009 MEAN	2005-2009 MEAN	2005-2009 MEAN
	Short season <0.5-1t/ha	Short-Medium seasons 1-1.5t/ha	Medium season 1.5-2tha	Medium-Long season 2-3t/ha	Long season 2.5-3t/ha
25	0.73	35	23	22	7
		1.24	1.79	2.40	3.28
<b>OZP0903 *</b>	144	116	110	111	112
<b>OZP0805 *</b>	129	122	120	105	99
OZP0602	122	113	109	108	100
OZP0703	121	112	112	105	98
OZP0601	127	110	107	104	94
Sturt	121	107	103	93	92
Kaspas	100	100	100	100	100
Parafield	104	100	95	90	94

\* Mean data based on fewer observations.

## Germplasm enhancement

### Future planning

Phil Davies

The first phase of the PBA Plant Germplasm Enhancement Program is coming to an end in June 2011 and planning is well underway for Phase II of this program. Phase I has seen some significant gains in identifying pulse germplasm with improved tolerance to heat stress, frost, salt, boron and waterlogging, and resistance to diseases including bacterial blight. Phase II will include focussing on validating these results, understanding the genetics of the traits, incorporating these traits into adapted lines which can be used by breeders and ensuring that the breeders have the tools to efficiently select for these traits.

The PBA Coordination Group, together with much background work by GE program participants and each of the breeding program leaders, has made significant progress in identifying new traits and re-evaluating priorities for GE Phase II. These priorities are currently being summarised, together with plans for the work required to most effectively make these traits available to the breeding programs.

### Black spot resistance in field pea

Kedar Adhikari and Tanveer Khan

Black spot (*Ascochyta* blight) is the most damaging disease of field peas in Australia and one of the biggest problems facing growers. Breeding work involving the WA Department of Agriculture and Food (DAFWA) and Pulse Breeding Australia (PBA) has made progress in developing field pea lines with potential improvements over WAPEA2211 which has partial levels of resistance.

In a 2009 trial there were at least 20 lines with potential resistance better than WAPEA2211. Eight of these lines yielded similar to or higher than Kaspas<sup>ϕ</sup>.

### ***Herbicide tolerance in break crops***

**Ping Si**

Weed control in grain legumes is an important issue in Australia. Herbicides have been the most effective method for controlling weeds and allow the practice of minimum tillage farming. The lack of herbicide tolerance in grain legumes has limited their sowing areas and production.

GRDC has funded PBA affiliated research projects at CLIMA to improve herbicide tolerance in break crops including narrow-leaved lupin, chickpea, field pea and french serradella. The conventional methods of induced mutation and germplasm screening are used in this project for these crops. Two breeding lines of chickpea were found to be tolerant to metribuzin (post-emergent) after screening over 100 genotypes consisting of cultivars, advanced breeding lines and land races.

Induced mutation also proves very effective in improving metribuzin tolerance and has provided mutants with higher tolerance. Two lupin mutants (Tanjil-AZ-33 and Tanjil-AZ-55) tolerant to metribuzin were identified in 2005. In 2009, CLIMA produced the second generation of the lupin mutants, with five times higher metribuzin tolerance than the tolerant cultivar Mandelup<sup>(b)</sup>. Higher tolerance is desirable as Mandelup<sup>(b)</sup> occasionally suffers metribuzin damage in the field. This work was undertaken by a visiting professor, Dr Gang Pan, from China's Zhejiang University.

Induced mutation has also been used to improve field pea tolerance to isoxaflutole (a herbicide currently only registered for use in Chickpea). Kaspera<sup>(b)</sup> was mutagenised and M2 seed was treated with isoxaflutole. Five M2 seedlings were isolated with increased tolerance and testing to confirm these results is being conducted this year.

### ***Waterlogging tolerance in faba beans and lentils***

**Peter Johnson and Geoff Dean**

Waterlogging can severely affect pulse crops and different crops have different periods of susceptibility. Faba beans are at most risk from winter waterlogging, while lentils and peas tend to be more prone to spring waterlogging particularly during flowering. At TIAR Launceston, last season's evaluation of waterlogging tolerance in faba beans revealed quite good tolerance in some lines, with Aquadulce being among the best. Tolerant lines were able to regrow a root system under waterlogged conditions. Further trials will be conducted this season with a focus on evaluating waterlogging tolerance in current faba bean breeding lines. Lentils were also screened for waterlogging tolerance at the vegetative phase prior to flowering. After two weeks of waterlogging, most lines had severe symptoms and later died, but some were able to regrow root systems. Lentils and a smaller quantity of pea lines will also be evaluated this year for tolerance during both the vegetative and flowering phases. Detailed studies will be made of the extent of root regrowth of both the faba beans and lentils.

### ***Heat stress tolerance in faba bean and field pea***

**Ahmad Maqbool and Thang Pham**

Heat stress is a significant production constraint for many pulse crops. Using a controlled environment heat chamber, the SARDI pulse GE team has identified several field pea and faba bean lines with reduced symptoms of heat stress compared to Kaspera<sup>(b)</sup> field pea and Fiesta faba bean. These lines have been sown at staggered seeding dates in the field at

Balaklava (SA) this season and will be evaluated following natural heat stress events. Further testing will also be carried out under controlled conditions to validate the initial selections and to measure additional parameters to gain further understanding of the physiology of heat stress tolerance in these lines.

Crosses between selected lines and Kasp<sup>Ⓛ</sup> and Fiesta have been made to understand the genetics of heat stress tolerance, and as the first step towards incorporating this trait into well adapted germplasm.

### ***Frost tolerance in pulses***

**Ahmad Maqbool and Jamus Stonor**

Radiant frost is a major abiotic stress, and one of the principal limiting factors for crop production in southern Australia. Pulse crops are very sensitive to chilling and freezing temperatures during the reproductive stage.

The SARDI pulse GE team has screened over 400 accessions of field pea from 39 countries, over 200 accessions of chickpea from 23 countries and over 100 accessions of lentil from 14 countries using a frost chamber to identify genetic variability. The germplasm has been sourced primarily from the Australian Temperate Field Crops Collection (ATFCC) at Horsham. Lines selected as frost tolerant are currently being validated by re-testing under controlled conditions and under natural frost events in the field. Crosses have been made in field pea as the first step in understanding the genetics of frost tolerance.

### ***Introducing new staff in PBA Pulse Germplasm Enhancement team***

**Kristy Hobson**

Dr Annathurai Gnanasambandam (who likes to be known as 'Anna') recently joined Victorian Department of Primary Industries as a Research Scientist to work on PBA's germplasm enhancement project. With a Master's degree in plant breeding and genetics from India and an MPhil degree in plant breeding and crop improvement from the Universities of Birmingham and Reading, UK, Anna moved to Australia in 1996 to pursue his PhD in plant molecular biology from the University of Queensland. After completing his PhD, he has worked on several plant molecular improvement projects in Brisbane for the last 9 years, particularly with sugar cane. In 2005, he was awarded one of the three prestigious 'Smart State Fellowships' from the Queensland Government, awarded to outstanding early career researchers. He completed a Graduate Certificate in Management degree in 2007. After spending 14 years in the 'sunny' Brisbane, he has finally decided to move to a 'cool place' like Horsham. He feels that his experience in both plant breeding and plant molecular biology will greatly help him to contribute to the germplasm enhancement project. When asked about his decision to move from Queensland to Victoria, his response was simple: "It took 14 years of me living in the 'Smart State' to realise Victoria is 'the place to be'".

We are very happy to have Anna at Horsham to lead our germplasm enhancement and molecular marker research. He has a great blend of breeding, phenotyping and molecular skills, a focused, organised and professional attitude towards work and a friendly personality that makes him perfect for the job. Anna has already become a valuable member of our team at Horsham and will be a great asset for PBA.

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*Pulse Breeding Australia (PBA) is an unincorporated joint venture between:*

- *Department of Primary Industries, Victoria (DPI Vic)*
- *South Australian Research and Development Institute (SARDI)*
- *Queensland Primary Industries and Fisheries as part the Department of Employment, Economic Development and Innovation (DEEDI)*
- *New South Wales Department of Industry & Investment (I&I NSW)*
- *Department of Agriculture and Food Western Australia (DAFWA)*
- *University of Adelaide*
- *Pulse Australia and*
- *Grains Research & Development Corporation (GRDC).*