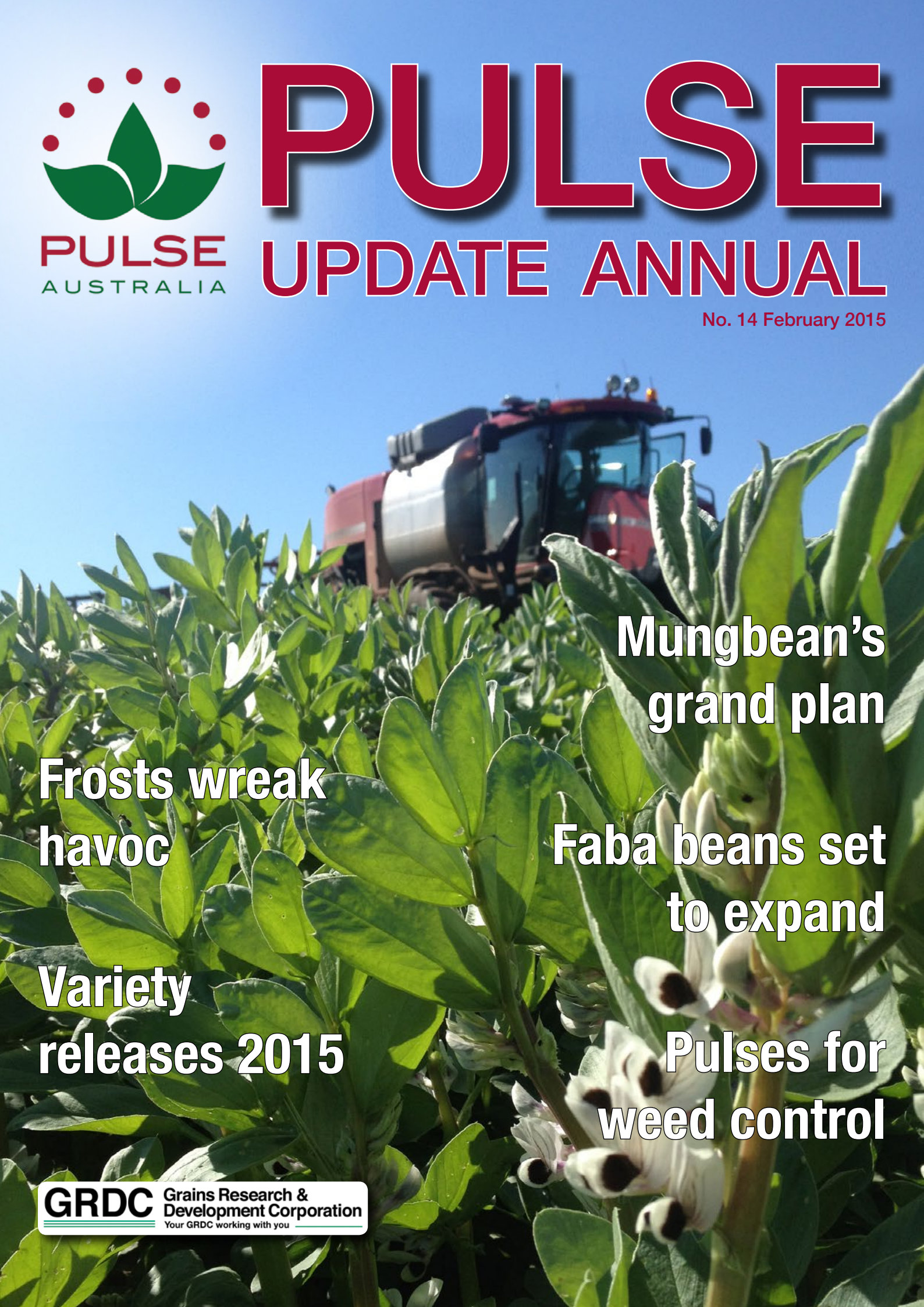

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PULSE UPDATE ANNUAL

No. 14 February 2015

Mungbean's grand plan

Frosts wreak havoc

Faba beans set to expand

Variety releases 2015

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Pulse Australia is the peak body representing all sectors of the Australian pulse industry.

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Editing, design & layout by Cindy Benjamin, 07 4155 6155

COVER: Spraying faba beans on Randall Wlksch' property, Eyre Peninsula, SA. Photo by Randall Wilsch, Wilsch Farming, Yeelanna.

From the Chief Executive Officer

Tim Edgecombe,
Pulse Australia

The 2014 season was characterised by plentiful early season rainfall in southern and western regions with little follow up rain mid-season and a hot dry finish with damaging frosts in some districts.

As a consequence the total pulse crop was estimated at around 1.7million tonnes, down 21% on the previous year. However it was pleasing to note that despite the lack of rain during the growing season the yields and grain quality were still respectable in most areas – this is a reflection of how far the industry has progressed in its ability to put in place breeding programs and agronomic practices that support crop development under difficult conditions.

The outlook for pulses in 2015 looks promising given the prevailing high prices of most pulse crops. In particular lentils, which have recently topped $1000 per tonne. The prices are somewhat underpinned by the relatively low Australian dollar but will ultimately be impacted by the Indian Rabi pulse harvest. If canola prices remain low we may see a significant switch to pulses as the preferred rotation crop in many districts.

Pulse Australia continued its delivery of the GRDC-funded Broadleaf Cropping Alliance Project in conjunction with Australian Oilseeds Federation (AOF). The project provides a critical extension

link between the research outcomes delivered by various State agriculture departments and universities and grower adviser/grower network and provides input into the process of identifying and prioritising future research projects.

NSW Industry Development

In May 2014, the NSW Department of Primary Industries and Pulse Australia announced the appointment of Tim Weaver to the position of Industry Development Manager – NSW. Tim will be responsible for assisting the Department, Pulse Australia and AOF to continue to develop profitable pulse and oilseed industries in NSW. Tim brings with him a wealth of broadacre crop knowledge gained from many years' experience with NSW DPI and more recently with Cotton Grower Services.

Standards Committee

The National Pulse Standards Committee met during the year to consider suggested changes to the Standards raised by the State Pulse Groups. After industry consultation it was agreed to change the receival standards for mould to allow for a very low tolerance of mould on delivery. Details can be found on the Pulse Australia and GTA websites.

AGIC Asia and Australia

Pulse Australia is a co-organiser of the Australian Grains Industry Conference (AGIC) that holds Australia's largest annual grain conference in Melbourne. In March 2014, AGIC held its inaugural AGIC Asia Conference in Singapore.

The conference provided an opportunity for customers and marketers of Australian grain to access the latest information on the Australian crop prospects, quality profiles, innovations and trends. AGIC Asia will host two events in Singapore and Hong Kong for customers/end users, marketers/traders, finance sector and other grain industry participants based in the region to hear the latest information on the Australian grain market and network with Australian grain industry participants.

GIMAF 'China Strategy'

Pulse Australia is a founding member of the Grains Industry Market Access Forum (GIMAF). GIMAF was successful in regaining access for Australian canola into China.

As a result of these successful negotiations, GIMAF has developed a 'China Strategy' to focus on attaining access for other grains, including lupins (for human consumption) and faba beans. During the year access was granted for split lupin for the Indian market.

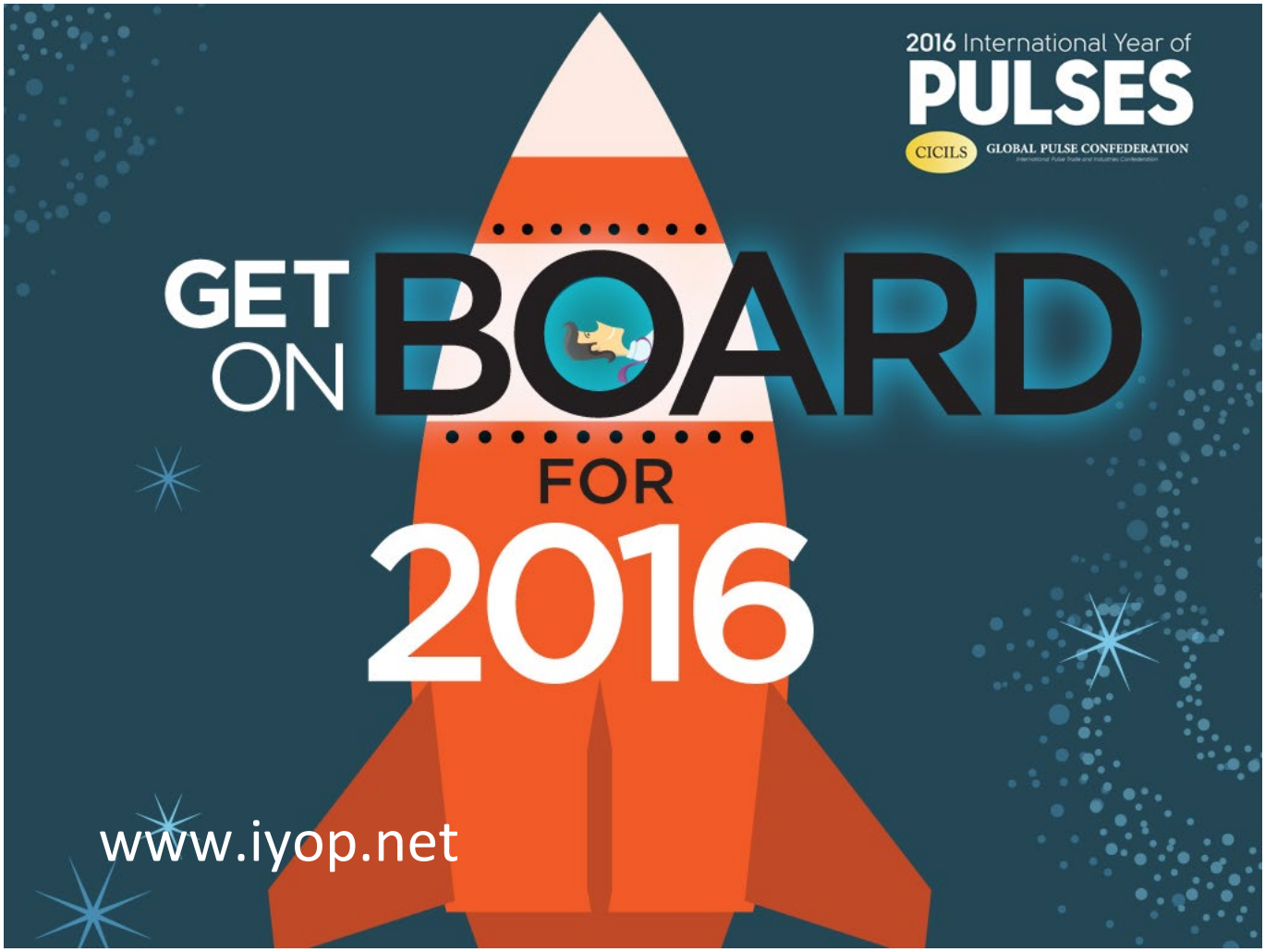
International Year of Pulses 2016

2016 has officially been declared 'International Year of Pulses' and CICILS (GPC) in conjunction with the Food and Agriculture Organisation of the United Nations developed four thematic areas to feature during the year:

- Creating Awareness
- Health Nutrition and Food Innovation
- Productivity and Sustainability
- Market Access and Stability
- Food Security

Australia is well represented on these Committees with Georgie Aley chairing the Global Creating Awareness Theme, Michelle Broome (GLNC) on the Health, Nutrition and Food Innovation and the CEO represented on the Production & Sustainability and Market Access themes.

A final thank you to GRDC and our supporter members without whose contribution we would not be able to continue to represent and promote this vital industry.



Professionalism shows in northern winter pulses

by Gordon Cumming
Pulse Australia

As I reflect on the 2014 winter cropping season in the northern region the one word that keeps coming to mind is 'professionalism'. By this I mean the level of professionalism our growers, agronomists and advisors display through their knowledge of production and marketing of pulse crops.

2014 saw an increase in faba bean production and another consolidating year for chickpea.

Traditionally, faba bean has been a crop best suited to southern Australia and its in the past poor yields and high disease pressure has marred the expansion into the northern region. Other than a core production region that developed around Narrabri and Wee Waa where faba bean has fitted into cotton irrigation systems using a pre-watering to ensure timely planting, the crop had not gained a foot-hold in the northern region.

This situation has changed dramatically in the last few years with the release of several new varieties with greater adaptation for the northern region from the faba bean plant breeding team at Narrabri.

The last of these releases was PBA Warda in the spring of 2013. This variety has performed very well, with better yields than the older varieties of Doza and Cairo, combined with better grain quality for the early season market.

PBA Warda has renewed interest in faba bean production in southern Queensland with an estimated 3500 ha being grown in 2014 around Dalby on the Darling Downs. Whilst yields were lower than desired, averaging 1.5 to 1.8 t/ha, the high price still made the crop very financially rewarding.

The agronomic advantages of faba bean are many, including an earlier planting window (early April) compared to chickpea, high biomass and high nitrogen fixation, different herbicide options compared to chickpea, and a different end market, providing some additional market risk management options for growers.

New crops often mean new challenges and faba bean is no different—but once again I return to my earlier comments about the professionalism of our producers. This year we saw early and very high aphid pressure in the faba bean crops on the Darling Downs, an event that nobody had really seen before. There was much discussion and a couple of industry meetings held to determine the best course of action—do we spray or do we leave them?

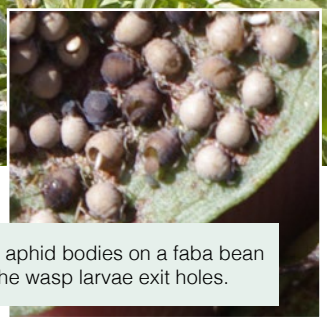
The considered advice from our best research entomologists was to not spray and to wait for the coming cold weather to kill the aphids off and there was evidence of some parasitism of the aphids by parasitic wasps. Just in case spraying was needed Pulse Australia gained an emergency use permit for the use of Pirimicarb.

Most stayed the course and did not spray for aphids and, sure enough the first cold snap obliterated aphid numbers. In many fields there was very clear evidence of high levels of parasitism, highlighting the value if IPM and natural enemies within the environment.

We may not have an opportunity to plant faba bean each season, with its requirement for early planting in April. In seasons where we have early rains this crop provides producers with yet another financially viable broadleaf crop.

As for our other winter pulse crop, in the last five years desi chickpea has really come of age, as not just a valuable rotational crop but as a significantly profitable crop that is a key component of rotations on most farms. Our knowledge and skill levels have grown to a point where many now comment that chickpea production is 'easy' and that their cereal crops are giving them more reason for concern. This is a big change in attitude from as little as five years ago when the industry was plagued with issues of poor disease management options, low yields and delivery quality issues.

The entire industry, from plant breeders and agricultural scientist to growers and agronomists, has banded together to address these challenges and to turn desi chickpea into the highly successful crop that it is today.



Parasitised aphid bodies on a faba bean leaf. Note the wasp larvae exit holes.

This is not to say that there are not still limitations, and it appears that each year brings something new to challenge the industry. At the start of the 2014 season things did not look all that bright as we came out of a dry summer and into a late winter break, which limited the amount of stored soil moisture in most paddocks, increasing the production risk. Combined with this, the price for desi chickpea was at a 4-year low and the market was slow moving.

However, most growers stuck to their core rotation, sowing at least some chickpea although they did lean to planting more cereal when and where they could. Even so, final crop forecast figures show that chickpea represented 27 per cent of the total winter crop planted area in Queensland and 23 per cent in northern NSW. In central Queensland chickpea represented 44 per cent of a much-reduced winter crop.

Yields varied due to many factors. The first, and main, problem was the extreme seasonal conditions—a cold start after emergence combined with little in-crop rainfall and an early, hot finish. Although most crops were planted into a good profile of soil moisture, the onset of cold weather delayed early growth, especially for late sown crops.

Some growers opted to sow on time using moisture seeking deep sowing but most chickpeas were sown late due to the lack of planting rainfall. Crops sown late struggled with a very short growing and fruiting period, yielding 0.8 to 1 t/ha, while the earlier sown crops reached yields of up to 2 t/ha, repaying growers for the risk they took early in the season.

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High quality grain a boon in 2014

Southern region pulse growers challenged but stay positive

by Mary Raynes
Pulse Australia

Growers could not of scripted a better start to the cropping season for 2014 with early April rains, ideal subsoil moisture and unseasonably mild growing conditions for weed-free crops to bolt out of the ground.

South Australian crops were in a particularly good position during May and mid-June, producing unusually high levels of biomass. However, during June many broadleaf grain growers across southern Australia saw an early and unexpected influx of green peach aphid (*Myzus persica*). Green peach aphids (GPA) are the vector for the luteovirus, Beet Western Yellow Virus (Family Luteovirade genus *Polerovirus*). GPA spread Beet Western Yellows Virus (BWYV) rapidly through canola crops, reducing yield potential by up to 60 per cent. The big concern for the pulse industry was how to protect susceptible pulse crops.

In a way it was fortunate that harsh frosts occurred in mid to late July, causing all aphid activity to cease, and pulse crops escaped any visual damage. However the frosts also brought to a halt the rapid crop biomass development.

June, July and August were very dry months, with most regions receiving only 30–40 per cent of the average rainfall. Despite the positive outlook to the season, the Mallee, Wimmera and central regions of Victoria and all regions in South Australia, except the south east and lower Yorke Peninsula, were starting to display visual signs of moisture stress.

By spring time the season was shaping up to be the worst in about 12 years for some growers, particularly in Victoria's Mallee and Wimmera regions.

Pulse, wheat and barley crops in Victoria's Mallee and northern Wimmera regions started to rapidly decline as the conjecture of low to below average spring rainfall and the onset of an El Niño became a reality, and deciles oscillated between 1 and 2.

Instead of the desperately needed September rains, growers were dealt several weekends of hot northly winds, warm days and some overnight low temperatures of just 3°C or less. At this stage the only regions expected to produce average pulse yields were Victoria's north east and south west districts and South Australia's Yorke Peninsula and south east regions. In all other regions the crop potential had fallen well below average and rainfall recordings were 80–90 per cent below average. The only up-side was that there was no disease pressure on any pulse crops for the season.

Hot, dry and windy conditions continued through October, flattening some faba bean crops in the northern region of South Australia and disrupting flowering. Many days were 33°C with strong winds, and most regions recorded less than half their average October rain. A severe frost on 17 October burst developing seed pods, burnt flowers off chickpeas and damaged the remaining pulse crops in the Mallee regions, northern Yorke Peninsula, the Adelaide Plains and Victoria's Wimmera. The longer season regions of South Australia and Victoria escaped any crop damage until the first week of November when another frost wiped out podded field pea and flowering faba bean crops.

Early sown varieties, not necessarily on the better soils, have performed the best under difficult conditions. Average to below average grain yields were the result across most regions with frost causing quality damage in some regions. The better quality grain and yields were produced in the north east and south west region of Victoria, south east South Australia, lower Eyre Peninsula and isolated areas of the Yorke Peninsula and mid north of South Australia.

Field pea harvest commenced the second week of October in South

Australia's Mallee and Eyre Peninsula. The Australian lentil harvest commenced the third week of October in the Victorian Mallee region and was ninety nine per cent complete by the end of November.

2014 dished up some surprising yields for the Yorke Peninsula and Eyre Peninsula and growers in drought-affected areas didn't have to travel far to see some good yields.

Three new lentil varieties and one new faba bean variety were available to the industry in 2014.

PBA Giant$^{\phi}$ a large green lentil, PBA Greenfield$^{\phi}$ a medium size green lentil and PBA Jumbo2$^{\phi}$ a large red lentil for the direct replacement of PBA Jumbo$^{\phi}$, and a faba bean, PBA Samira$^{\phi}$ (see page 20 for descriptions of new pulse varieties).

Selecting pulses for 2015

The last harvest price and crop performance are not good reasons for swapping out of one pulse commodity to another. Yield and price combinations rarely remain the same from year to year and it is very difficult to forecast the pulse market for the coming year. Assessing the production and marketing risks associated with each pulse crop is important, in conjunction with matching pulses to the ideal soil type and providing excellent agronomic management to achieve the best possible result for the season.

Lentils performing well

Lentil prices for 2014-15 broke new ground and continued to maintain a bullish price after a low 2011-12 year. Although well below average yields were achieved due to very low in-crop rainfall, overall production was slightly higher than in 2012-13.

The real beauty about today's Australian lentil industry is the availability of varieties that suit particular growing regions and offer specific agronomic traits. In 2014 a second herbicide tolerant, high yield medium size red lentil with a grey seed coat colour was launched onto the market. PBA Hurricane XT$^{\phi}$ set a record for the biggest first year uptake of any new variety with just over 1000 t of seed being sown. With the release of two new green lentils, a small and medium seed size, Australia is on track to reclaim and own the domestic green lentil market, competing with green lentils imported from Canada.

Canada and Australia continue to produce very high quantities of lentils, mainly because the new varieties and farming systems make lentils the most profitable pulse option at current prices, in areas suited to the crop.

In 2015 expect to see an increase in the area sown to lentils due mainly to significant rainfall events in mid-January across traditional lentil growing regions of southern Australia. Favourable subsoil moisture, the depth of lentil varieties with various agronomic benefits to choose from, an increasing lentil price trend (>$900/t) and a decreasing canola price all support increased lentil plantings.

Growers and agronomists will benefit from the lentil training courses being run this season at selected locations in the southern region (see page 15).

Faba beans positive outlook

Pulse Australia predicts that the area of faba beans grown across southern Australia is set to rise slightly compared to 2014 on the back of acceptable yields, exceptional prices over the last four years and significantly, some grain marketing companies setting up receival sites in regions that traditionally have not had access to localised delivery sites for beans. These new pulse receival sites reassure growers that they can sell their product locally rather than having to bear the cost of freighting beans to depots several hundred kilometres away.

Growers and agronomists will benefit from the faba and broad bean training courses being run this season at selected locations in the southern region (see page 15).

Chickpeas on downward trend

Following two years of low prices for chickpea and large global supplies, the area sown to chickpeas could potential decrease further. When selecting a chickpea variety it is essential to consider its resistance to ascochyta blight along with yield, price potential, marketing, delivery, maturity, lodging resistance and other agronomic features relevant to your growing region.

Choose a desi or a kabuli type that suits your marketing plans, the region and farming system. Larger-seeded kabuli chickpeas like Genesis™ Kalkee are later maturing than Genesis™ 090. A price premium for kabuli over desi is necessary to compensate for lower yield and higher seed costs. Gross margins, marketability and personal choice can often be deciding factors.

Chickpeas do not fit into rotations and farming systems as easily as other pulses, and are far less competitive against weeds. Terbyne® and Balance® offer effective control of most broadleaf weeds, but post-emergent options are limited and can affect crop yield potential. Croptopping is not possible with most chickpea varieties and, if attempted, will affect yield and quality, even with the earlier flowering desi varieties like PBA Striker$^{\phi}$, Ambar$^{\phi}$, Neelam$^{\phi}$ and the kabuki varieties like PBA Monarch$^{\phi}$ and Genesis™ 079.

Lupins are back

The area sown to lupin in Victoria increased in 2014 following stronger prices being paid in 2013-14, after several years of low prices and demand. Price will ultimately determine the area sown to lupin in 2015. Prices are currently good and there is more international and domestic demand. The Australian end-users looking for lupin will need to provide growers with confidence in their market if the area sown to lupin is to increase markedly.

Albus lupin markets have improved since record production in 2010 swamped the limited export market into the Middle East. Fortunately stocks are now somewhat depleted and feed millers are also using albus lupin in their mixes, but at feed prices. Overall the area sown to lupin across southern Australia for 2015 is expected to be similar to the 30 000 ha sown in 2014.

Field peas hang in there

Growers could benefit from the new short-season varieties that also offer high yield potential. It has now also become clear that, in areas regularly prone to bacterial blight, it is important to grow varieties with better resistance, such as PBA Percy$^{\phi}$. Variety choice, stubble management, crop sowing dates and seed hygiene are vital components of a disease minimisation strategy. Use the 'Blackspot manager' to determine the optimum sowing dates in your area to minimise the risk of this disease limiting yield potential. The area sown to field peas across southern Australia for 2015 could be similar to slightly less than the 203 000 ha sown in 2014.

Meeting receival standards

This below average harvest has seen minimal weathering and quality issues, but some insect damage has had an impact in isolate areas. Meeting pulse receival standards at harvest can sometimes be a challenge and each year seems to present a different problem with one or more pulse variety.

Croptopping is widely practiced in pulses to prevent weed seed set but there is always potential for this to affect pulse grain quality. Growing earlier maturing varieties helps to enable effective croptopping while avoiding a grain quality penalty. Assess each individual situation at croptopping and again before commencing harvest.

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Cropping in WA

getting harder for some and easier for others

by Alan Meldrum
Pulse Australia

How should I describe the 2014 season in WA? As in most recent years, it was a mixed bag across the agricultural regions with erratic rainfall a highlight of the season. What distinguished the 2014 season in particular were the temperatures: it was very warm.

In the Geraldton and eastern Kwinana regions, temperatures hit 34°C in August after a long dry period. While lupins suffered immediately, it was not until harvest time that the damage was evident in cereals.

There was little to no summer rain across WA in 2014, making for a nervous wait for the break to the season. It had to be a good break to counteract the extremely dry soil, and fortunately it was.

Substantial rain fell across the northern and eastern regions in mid to late April, leading to a huge boost in seasonal prospects and ideal sowing conditions. In the southern region, good rain finally arrived in early May, again providing good sowing conditions. In contrast, the Esperance region received barely enough rain to commence seeding and the follow up rain was only adequate to maintain seedlings without adding to the subsoil moisture bank.

And that was about it for winter in the northern and eastern districts until spring! This made the extremely warm August all the more dangerous. Lupins suffered badly where soil constraints limited root growth, while cereal pollen suffered in the heat and failed to establish each plant's potential number of grains. Unfortunately, spring rainfall was below average and final yields were poor to well below average.

Spring rainfall was average to above average in southern and western districts of these regions, producing very good yields and fulfilling the yield potential developed in May.

Rainfall was below average during winter in the southern regions but was timely and mostly in good quantities to allow average to above average growth in lupin, field pea and faba bean crops.

Spring rainfall in the southern and Esperance regions was well above average and the lack of damaging frosts allowed very good yields in all crops. The lack of deep moisture from the dry winter in Esperance reduced the final result to an average season, but this was better than was anticipated earlier in the year.

Charcoal rot in lupins caused a great deal of concern in September. Charcoal rot is a little known disease that takes advantage of droughted plants, usually at senescence in October. It is rarely seen earlier in the crop growth cycle but 2014 produced conditions for it to be widespread in September, finishing off plants far earlier than normal.

To add to the problem, many lupin paddocks in the eastern districts of the Geraldton region showed regrowth with spring, delaying harvest and, in some cases, required desiccation. Consequently lupin yields were poor is these districts.

Where lupins did not have a substantial soil constraint to deal with, yields were above average on the back of the deep moisture provided by the strong break to the season.

The more recent lupin varieties PBA Barlock$^{\phi}$ and PBA Gunyidi$^{\phi}$ showed their worth by topping the trial yields in most districts. Jenabillup$^{\phi}$ performed well in southern districts and withstood Bean Yellow Mosaic Virus very well, out-yielding PBA Barlock$^{\phi}$ by 300 kg/ha in one case.

The field pea sown area was lower again in 2014, principally in the Esperance region, driven down by the profit potential of canola. Yields were about average in the main with PBA Gunyah$^{\phi}$ and PBA Wharton$^{\phi}$ being strong performers.

And what are the prospects for pulses in 2015?

Lupin prices remain strong and the area should increase this year despite the setbacks of last season. Canola yields are showing some decline with nematodes building up in tight rotations. This scenario makes lupin an attractive option to reduce the impact of nematodes.

The field pea area is likely to remain low for a number of reasons. However, growers should watch the Indian winter crop forecast to gauge if demand for field peas may underpin prices. If there are prospects of a shortfall in domestic pulse production in India, field pea pricing may well increase in 2015.

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Albus lupins central to the rotation

Mark Robinson took a chance in 2014, sowing lupins later than usual into sub-optimal soil moisture. Unfortunately the season did not come good and in the end the crop did not quite make 1 t/ha. Mark will make the best of a bad lot though, taking advantage of an upward swing in price after harvest.

by Cindy Benjamin

Red sandy loam and minimal risk of frost are a perfect combination for albus lupin. For 11 years Mark and Cherie Robinson have grown 300 to 400 ha of albus lupin on their 2100 ha property near Coonamble in northern NSW.

"In good seasons our lupins grow almost to shoulder height so this year's crop seems disappointing at only knee height," says Mark. "But that's what the season has been like."

"In a good year the stored moisture is sufficient to grow the lupins with minimal in-crop rainfall needed," he says. "This season we relied on in-crop rain that never came and the crop averaged a disheartening 0.95 t/ha yield."

The Robinsons have tried chickpeas in rotation with cereals and canola but have found that lupins are the best fit pulse crop for their farming system. Mark says the extra $100/t paid for human consumption grade lupins exported to Egypt is well worth chasing. The market is relatively small and in good production years there is always additional scrutiny of the grain quality.

"The 2010 season was particularly good with high yields and, following the excellent prices of 2009, over $700/t for human consumption grade lupins," he says.

"Exceptional prices are just that though. The drop in price for the 2010 season to $250 per tonne was dramatic but offset by yields of 3 t/ha. Average prices around the $400 to $500 per tonne plus the rotational benefits of growing a legume make lupins a very viable option."

Paying close attention to crop protection has been an important part of the Robinson's success with lupins. While diseases are not usually a problem it is important to monitor for pests. Helicoverpa are the main insect pest and must be controlled from flowering onwards. Their local Landmark agronomist, Graeme Proctor, plays a big part in their pulse crop success, monitoring the crop for insects regularly during this critical period. Mice and feral pigs are the other pests that can have significant impacts on lupin yields.

'Nyleve' was formerly a grazing block and when they purchased it in 2003 there were serious weed challenges to overcome. The Robinsons used crop rotation and a summer fallow spray program to bring weeds under control. They set each crop up for strong germination and use residual herbicides such as simazine and diuron incorporated by sowing (IBS). Mark keeps an eye out for broadleaf weeds in the lupins and cleans them out in-crop if necessary.

"Pulses can be difficult to grow if there is significant weed pressure but it is possible to bring weeds under control through a planned and consistent program," he says.

"Lupins are grown every four or five years in each paddock in rotation with canola, wheat and barley so we have opportunities to get the upper hand on broadleaf weeds leading up to sowing lupins."

Depending on soil tests they often apply MAP at around 30–50 kg/ha with a seeding rate of 80–100 kg/ha. In 2014, no fertiliser was applied due to a failed 2013 crop leaving enough residual nutrient. As Mark says, this part of northern NSW has been seriously rain deficient since June 2012, making management decisions very difficult.

The Robinsons avoid growing wheat on wheat and estimate that the lupins grown before wheat add another 0.5 to 0.6 t/ha to the wheat yield.

Prior to purchasing 'Nyleve' Mark had worked as an agricultural contractor concentrating on harvesting, windrowing and spraying. He says the set up at the front end of the header is vital when harvesting lupins. Using a rotary header with a belt front, rather than a conventional front, with a table auger, Mark sets the finger reel high and slow so that it is gentle on the pods to avoid shattering them as they go over the knife.

"Rotary machines are the most gentle on the grain, allowing good cleaning capacity whilst not cracking the seed. A poor sample can be downgraded to Lupin 2 with a substantial price drop," he says.

The Robinsons save as much on-farm storage space as possible for their lupins, storing only enough wheat and barley seed for next season. Their experience with marketing lupins is that prices always rise after harvest and there are usually other price spikes through the year.

"We aim to have everything sold by August but there is no pressure to sell everything early," he says. "Buyers are looking for lupins all year, not just around Ramadan, so you can monitor the markets and sell when you think the price is about to peak."

"We aim to store 500 to 700 t of lupins each year and can usually sell them at a couple of hundred dollars a tonne more than the price offered at harvest. Provided the grain goes into the silos at 13.5 per cent moisture or less lupins store very well and are very easy to handle."

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Lupin return has promise

Chris Martin (left), Australian Seed & Grain manager, Moora with grower Bill Waters inspecting lupins on Mr Waters' Gabalong farm, north-east of Perth.

by Cindy Benjamin

Gabalong grain grower Bill Waters is in the fortunate position of seeing new grain varieties perform on his own farm before they are commercially released. This gives him a glimpse of the future, and for lupins, the future is looking good.

Over the last five years Bill has been involved in the seed bulking-up phase of the Seednet variety release program for lupin and field pea. He says the new varieties that have been released, and those in the pipeline, are performing well and overcoming many yield and disease barriers.

"The latest lupin release, PBA Barlock$^{\phi}$, has better disease resistance than the varieties it replaces and has an exceptionally long flowering period to maximise yield potential," he says.

"In 2013 we had nine lupin varieties planted on the farm and PBA Barlock$^{\phi}$ out-performed all currently available varieties," he says. "Because the crops in the commercial seed program are being tested for their ability to perform in field conditions we are required to plant thinner than most growers would and can not apply any sprays for croptopping or disease control."

"This really tests the varieties and those with particular traits really stand out. It also reassures us that the new varieties will perform well even in difficult field conditions."

In 2013 his lupin crops were planted dry into loamy soil and received 240 mm of rain during the growing season, but Bill says this rain proved very effective and the crop responded with yields of over 3 t/ha.

Bill sows his own commercial crops at heavier seeding rates and finds that lupin competes well with weeds. "PBA Barlock$^{\phi}$ is a taller plant type than current varieties so it will provide more shade on the ground earlier in the season," he says.

"Growing lupins also gives us the opportunity to croptop for annual ryegrass control and we can time post-emergent sprays to best impact on weed numbers."

While aiming to retain all crop stubble on the field, Bill does some stubble burning specifically to help manage harvest weed seeds.

"In 2013 there was significant disease pressure due to the weather conditions but there was no sign of disease in the lupins," he says. "The field peas on the farm were affected so we know there was significant inoculum present."

Bill grows field pea, canola and lupin in a standard rotation with wheat on his 2400 ha property north-east of Perth. All the new varieties of field pea, PBA Kaspa$^{\phi}$, PBA Gunya$^{\phi}$ and PBA Twilight$^{\phi}$ have performed well, other than their susceptibility to foliar diseases.

"Field pea makes the greatest contribution to soil nitrogen stores, giving up to three years of nitrogen value to following cereal crops," he said. "Lupin also makes a useful contribution, allowing us to cut our fertiliser rate at sowing by more than 30 per cent in the following wheat crop."

Pulse Australia industry development manager, Alan Meldrum says interest in lupins is certainly increasing after the success many growers experienced in 2013.

"The current varieties all performed well and in many cases generated gross margin returns to growers in excess of that received for wheat in the same season," he says. "There is strong grower interest in PBA Barlock$^{\phi}$, which became commercially available for the first time in 2014."

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Longer rotations better all round

by Cindy Benjamin

The Wilksch family of Yeelanna, South Australia have fine-tuned their agronomic practices and are now able to grow faba beans on soils that would have been considered unsuitable in the past.

There have been pulses in the Wilksch family cropping rotation since the 1970s when Max Wilksch was one of the first growers on the Eyre Peninsula to grow peas and lupins.

The pulses underpinned a shift from ley farming to continuous cropping and remain a key component for the management of soil fertility, pests and diseases. Brothers Randall and Jordan and their wives, work in partnership with Max and Julie, farming 3600 ha at Yeelanna and Karkoo, north of Cummins.

Having trialled chickpea, field pea and vetch in the past the Wilksches have settled on growing primarily faba bean as the legume component in their rotation.

"The soil types here vary enormously and the rapid changes in pH within a paddock make it very difficult to grow an even pulse crop," says Randall. "Pulses make up about 20 per cent of our cropping program, in rotation with wheat, barley and canola."

While favouring faba beans for their agronomic fit and profitability, the family also grow lupin on their sandy soils and lentil on the red-brown earths. The additional freight costs to deliver lentils to Adelaide makes them a marginal proposition financially but still worthwhile for providing a valuable break on the difficult soil types.

"We deliver faba beans to a local aggregator at Cummins and they are shipped out of Port Lincoln, keeping freight costs down," says Randall. "The bulk shipments keep the price high but once the shipment is filled the price usually drops off. The faba beans from this area are well accepted in the market as high quality."

With many years of experience behind them, the Wilksches have fine-tuned their agronomic practices and are now able to grow faba beans on soils that would have been considered unsuitable in the past.

"We have access to new high yielding varieties growing in a no-till system with lots of stubble, a strategic fungicide program for foliar diseases, like chocolate spot, and we pay attention to the zinc and manganese requirements of the crop," he says.

Seed is inoculated at every planting using the peat slurry method, although Randall is considering using granular inoculant products in the future for sowing in drier conditions. The peat slurry system is cost effective and Max has developed an efficient process for inoculating the seed.

The seeding operation starts toward the end of April with canola then the beans go in early in May. Provided there is sufficient soil moisture to sustain the rhizobia the beans can go into fairly dry soil conditions. Within three days of seeding a flat drum roller is used to promote even germination and to make harvesting easier.

"We cut the beans very low to the ground and windrow them rather than croptopping," says Randall. "Our ten-year rolling average is 2.2 t/ha for the bean crops."

Herbicide resistant annual ryegrass is a constant management issue and is one of the reasons why pulses are a permanent feature of the Wilksch's cropping program, providing different chemistry options for weed control.

Wild radish is becoming increasingly difficult to manage and Randall has even used hand rogueing of wild radish in lentils to minimise its spread. Although a more difficult task than spraying he was very pleased with the beneficial effect of the hand rogueing in 2013's lentil crop.

"The pre-emergent Terbyne® has also given good results for wild radish in faba beans," he says. "In 2014 we planted the imi-tolerant lentil variety, PBA Hurricane XT(t), to give us another option for radish control in the lentils."

Although Randall doesn't like burning narrow windrows in pulses he does burn in some years, in paddocks with higher levels of weeds present at harvest. He has also achieved good control of ryegrass using the swather to apply glyphosate under the windrows as a commencement of fallow operation. After harvest they clean up any late ryegrass with an application of paraquat.

Randall says there is no question over the value of pulses in their rotation. "Wheat is certainly better after a faba bean crop than after a canola crop," he says. "I have real concern over the dominance of the canola / wheat rotation in this area, particularly with the increased incidence of Beet Western Yellows Virus and the green peach aphid, diamondback moth and blackleg in canola, and increasing levels of eye spot in wheat."

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DPI Technical Specialist, Pulses and Oilseeds, Mr Don McCaffery (left) and Pulse Australia national development manager, Gordon Cumming (right), announce the appointment of Mr Tim Weaver (centre) to the new role of pulse and oilseed Industry Development Manager for NSW.

Broadleaf crop industry development manager for NSW

In May 2014 the Department of Primary Industries (DPI) and Pulse Australia announced the appointment of Tim Weaver to the new role of industry development manager for NSW.

The appointment is a joint initiative designed to increase farm profitability for NSW broadacre farmers.

Pulse Australia's national development manager, Gordon Cumming said the position, based at Wee Waa, will better serve the needs of NSW grain growers.

"Mr Weaver brings a great wealth of knowledge and experience to the role having worked in cotton research before moving into broadacre grains technical and extension roles in the northern NSW region," Mr Cumming said.

"He will be working with advisers, growers and other sectors of the pulse and oilseed industries and will lead the development of innovative management strategies to increase the profitability of these industries in NSW."

DPI Technical Specialist, Pulses and Oilseeds, Mr Don McCaffery said the appointment will deliver vital support to both advisers and growers.

"There are significant development opportunities for broadleaf crops in all of the major cropping regions and Mr Weaver's appointment will give advisers and growers the right tools for the development and adoption of these crops," Mr McCaffery said.

"Mr Weaver will have a state-wide role, delivering industry intelligence and working closely with researchers, farmer groups and agronomists to ensure industry needs are being met.

"In partnership with Pulse Australia, the Department is committed to expanding the pulse and oilseed industry in NSW."

Mr Weaver will contribute to the national GRDC-funded Broadleaf Cropping Alliance, a collaboration between Pulse Australia and the Australian Oilseeds Federation.

Mr Cumming said the recent appointment brings the number of industry development managers working on the National Broadleaf Cropping Alliance project to four.

"We've seen remarkable response to the activities of industry managers in supporting grain growers to expand broadleaf cropping across the country and are looking forwarding to working with Mr Weaver to support to NSW growers," Mr Cumming said.

Since his appointment Mr Weaver has been actively promoting pulses at field days and through the media. He assisted with the presentation of modules of the Mungbean Best Management Practice training courses at Goondiwindi and Narrabri and has been working with other industry experts to develop a BMP course manual for faba bean production in the northern region.

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A valuable industry legacy

In 2014, experienced and well-respected senior industry development manager, Wayne Hawthorne moved into a well-deserved retirement.

In 2010 Wayne's contribution to the pulse industry was recognised with the highest industry honour—the Grains Research and Development Corporation (GRDC) Seed of Light award for the southern region—recognising excellence in grains research and development communications.

Wayne's involvement with the emerging pulse industry began in 1970 when he graduated with a Masters degree in Agricultural Science. Pursuing an interest in the nutritional aspects of grain, Wayne began his career with the South Australian Research and Development Institute (SARDI) as a research officer, initially involved with investigations into the benefits of lupins in stock rations.

He soon immersed himself in the development of the industry as SA State agronomic research and extension coordinator, collaborating with the national breeding programs for chickpea, lupin, faba bean, field pea and lentil, in addition to supervising SA breeding evaluation projects.

Before long Wayne established a reputation as one of the key technical authorities on agronomic management for pulses at both state and national level. He was appointed SARDI's senior research officer for pulses, taking on the additional responsibility of coordinating the relationship between the department and the industry value chain.

He was a driving force behind several industry groups including Pulse South Australia and SA Department of Primary Industries (PIRSA) Pulse and Oilseed Industry Development Committee.

Retiring from SARDI in 2003, Wayne joined Pulse Australia Limited as southern region pulse crop development officer, where he continued to assist the industry through a consolidation period.

As the SA representative on the national pulse standards committee, he played a driving role in the development of harmonised import/export trading standards across all states.

Wayne authored many information products that have assisted growers as the pulse industry expanded across the southern region. *The grain legume hand book* and *Pulses nutritional value and their role in the feed industry* are recognised as key reference works for the industry.

National development manager Gordon Cumming said Wayne's dedication, experience and knowledge has had a significant and lasting impact on the pulse industry in Australia.

"Over the last few years Wayne has coordinated the production of Southern Best Management Practice training manuals for chickpea, faba bean and lentil cropping," he said. "These publications are a key component to the training workshops offered to growers and agronomists and represent a significant legacy of Wayne's career."

Hugh Brier wins 2014 GRDC Seed of Light award

by Sarah Jeffery

One of Queensland's most highly respected entomologists, Hugh Brier won the prestigious 2014 Grains Research and Development Corporation (GRDC) Seed of Light Award.

Initiated in 1999, the GRDC's Seed of Light Award is presented annually to an individual who has made a significant contribution to communicating the importance and relevance of research outcomes to the wider grains industry.

GRDC Northern Region panel chair James Clark said Mr Brier's commitment to furthering growers' knowledge and understanding of key crop pests was widely recognised.

"The Australian grains industry is incredibly fortunate to have skilled professionals like Hugh Brier who dedicate significant time and effort to furthering the industry's knowledge and understanding of insect pests and how to manage their impact through integrated pest management programs.

"The communication of research work being undertaken and its relevance for growers' management at a paddock level is critical in the on-going quest to improve profit margins within the farming system."

Mr Brier's career began in 1974 as an experimentalist with the Queensland Government based in Toowoomba before being transferred to his current base of Kingaroy in 1975.

In the late 1970s and into the 1980s he undertook the original survey work on peanut white grubs in the South Burnett including the time-consuming process of rearing larvae through to adult moths to determine timing, temperature and diet interactions.

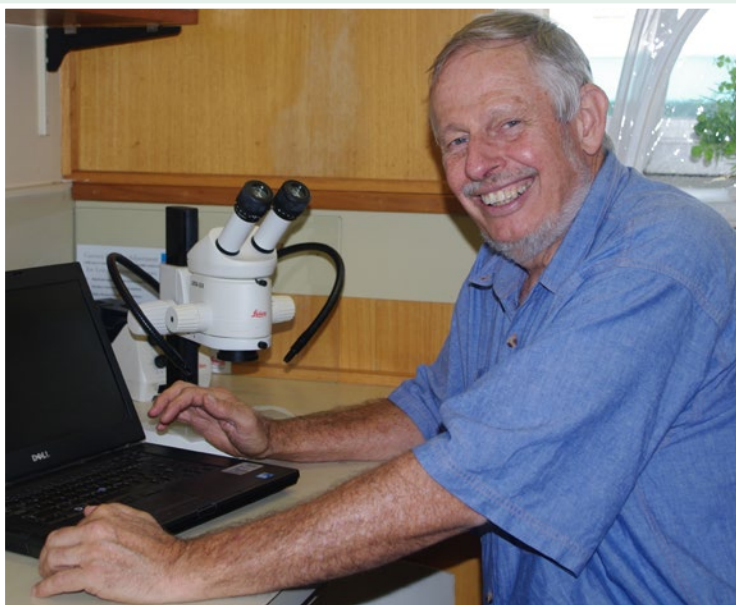
Over that same period he made connections with entomologists in the United States working on plant resistance in soybeans to lepidoptera and began testing the US material against local lepidoptera.

Mr Brier's professional interest expanded to podsucking bugs during the 1980s and his work with species such as helicoverpa culminated in the award of a Masters degree from The University of Queensland and subsequent promotion to the position of Entomologist.

More recently he has pursued the development of economic thresholds for helicoverpa, mirids and podsucking bugs in mungbeans and soybeans.

His passion for integrated pest management (IPM) underpinned the provision of IPM courses for coastal soybean growers and he has played a key role in the development of Queensland's coastal soybean industry.

Mr Brier has produced numerous publications to assist growers and agronomists in correctly identifying and managing the multitude of possible insect pests in pulses, including a summer pulses chapter in the 2007 *Pests of Field Crops and Pasture* book (PT Bailey ed), IPM workshop manuals and agronomist accreditation manuals, and more recently the *Good Bug Bad Bug?* book.



Lupins star in WA Day Signature Dish

Rhiannon Birch's close ties to the lupin food industry was clear as she presented the WA Signature Dish judges with Dorper lamb in lupin and za'atar crust with Moroccan sweet potato and lupin salad.

The Buy West Eat Best's inaugural WA Day event showcased regional produce that is distinctly West Australian and Ms Birch's dish took out the main prize, turning the limelight on lupins as a versatile addition to gourmet food.

Ms Birch, Lupin Foods Australia's digital marketing officer and daughter of a Coorow lupin farmer, represented the region of Perth & Surrounds in the competition.

Three other grand finalists competed with her onstage at the Perth Cultural Centre representing the regions of Great Southern, Southern Forests and the Gascoyne, following an eight week competition in the regions.

Chief judge, restaurateur Guillaume Brahimi, praised Ms Birch's creation as 'unmistakenly West Australian', teaming the rarely used lupins with the Dorper lamb cutlets and in the accompanying salad.

WA's Signature Dish competition is unique in Australia, giving talented home cooks the chance to express their ideas and showcase the produce of WA's regions.

Television personality and cook Anna Gare and WA food ambassador Don Hancey compered the battle and the dishes were judged by a panel of high profile food industry experts—Guillaume Brahimi of Bistro Guillaume, Ralf Vogt, Executive Chef Crown Perth and Rob Broadfield, well-known food critic and columnist for *The West Australian*.

MORE INFORMATION: Buy West, Eat Best: www.buywesteatbest.org.au

Australian Grains Industry Conference (AGIC) in Australia and Asia 2015

The Australian Grains Industry Conference (AGIC) is the must-attend event for senior executives, traders and others interested in the Australian grains industry.

AGIC is the premier industry-hosted conference for grain industry market participants and service providers.

Following the success of the inaugral AGIC Singapore in 2014, there will be two AGIC events in Asia in 2015.

Australian Grains Industry Conference Asia

THE AUSTRALIAN GRAINS INDUSTRY CONFERENCE SINGAPORE 2015

9 March 2015

THE AUSTRALIAN GRAINS INDUSTRY CONFERENCE HONG KONG 2015

11 March 2015

www.ausgrainsconf.com/asia

Australian Grains Industry Conference Australia

27–29 July 2015

Melbourne, Australia

www.ausgrainsconf.com/australia

THE AUSTRALIAN GRAINS INDUSTRY CONFERENCE 2015

Pulse crop training workshops held in all growing regions give agronomists and growers extra confidence with pulse crop production.

The 2015 courses will focus on lentil, faba bean and chickpea production and marketing.

Pulses are not difficult to produce, but they are distinctly different to cereals, oilseed and cotton crops. It is important for first time or inexperienced growers to get good advice.

Strong international interest in pulses, combined with increased grower confidence in varieties and growing practices, has led to a steady increase in plantings of several pulses over the last three to five years across most of Australia.

The best management practice courses cover the A-to-Z of pulse production and offer participants the opportunity to engage in open conversation with a range of specialists, including growers, discussing different management practices suited to different areas. A comprehensive manual is available only to workshop participants and provides a source of on-going support and information as the season progresses.

The courses provide the science and reasoning behind the recommended management practice and an update on the latest research and advancements in the pulse industry.

Growers are encouraged to choose Pulse Australia-accredited agronomists to provide planning and in-crop advice on pulses.

The courses are conducted in conjunction with leading pulse researchers from GRDC-funded projects in the respective government departments of each state.

Lentil, faba bean and chickpea will feature in the 2015 BMP training program funded by GRDC. Growers and advisors wanting to reserve a place at these workshops can contact their Pulse Australia industry development manager or send an email to subscription@pulseaus.com.au to express their interest.

BMP COURSE DATES (dates and locations are subject to change)

South Australia		
Balaklava	Lentil	17 March
Lameroo	Lentil	18 March
Victoria and southern NSW		
Lake Bolac	Faba bean	24 March
Wagga Wagga	Lentil	31 March
Queensland and northern NSW		
Goondiwindi	Faba bean	17–18 March
Narrabri	Faba bean	24–25 March
Dalby	Faba bean	31 March – 1 April
Goondiwindi	Chickpea	21–22 April
Goondiwindi	Chickpea*	23 April

*One-day upskilling course open to past course attendees only

Register: subscription@pulseaus.com

Regional Pulse Agronomy Projects

Southern Region

The extreme weather throughout the 2014 cropping season has challenged research agronomists as well as growers. With no useful rain after August, crops struggled to maintain yield as soil moisture was depleted. In many areas frosts also had a devastating impact.

The biggest surprise was how well pulse crops stood up to the adverse conditions, with lentils performing particularly well in a year of high demand. Lentil crops of 0.5 t/ha have achieved gross margins similar to 1.5 t/ha wheat crops.

Trials in the Wimmera were particularly affected by the frosts with over 40 days during flowering and podding recording minimum temperatures below 2°C. However in research this is not always a bad thing as the data reveals useful information about crop responses to adverse conditions.

The Southern Pulse Agronomy Program delivers applied research outcomes related to increasing the on-farm productivity, reliability and profitability of pulses in the southern region, including:

- analysing the profitability of medium-sized kabuli chickpeas, in response to the increased production of small kabuli chickpea in other countries, including Russia
- assessing new blue field pea varieties for their compatibility with croptopping for weed control and ways to minimise seed bleaching
- testing the new green lentil varieties' responses to disease management and harvest timing
- developing herbicide management tactics in herbicide resistant lentils
- developing best practice agronomy for the new PBA Samira$^{\phi}$ faba bean, including disease, canopy and nutrition management recommendations
- testing stubble management options in lentil
- assessing field pea and vetch for forage value and manuring for weed control and nitrogen input benefits.

Dr Jason Brand, senior research agronomist–pulses, Victorian Department of Environment and Primary Industries leads the Southern Pulse Agronomy Program. As a joint initiative of the GRDC, DEPI Victoria, NSW DPI and SARDI the program incorporates 45 trials across 17 sites in southern NSW, Victoria and South Australia.

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Northern Region

The Northern Pulse Agronomy Initiative is developing crop agronomy packages for the new chickpea, faba bean, mungbean, soybean and peanut varieties bred for the northern grains region.

Dr Rao Rachaputi from Queensland Alliance for Agriculture and Food Innovation (QAAFI), University of Queensland, is leading the project team in Queensland to develop regionally-specific agronomic practices for popular pulse varieties, including pre-release lines identified in the plant breeding programs for the respective crops.

The overall aim of the project is to support the adoption of pulse crops from the current eight per cent of the cropping area for winter pulses and four per cent for summer pulses to 15 per cent and 10 per cent respectively. Farm profitability will be significantly increased if average pulse production can be reliably increased by as little as 10%.

Trials in winter 2013 investigated the interactive effects of environment and management on yield and quality of three chickpea varieties in three locations—Dalby, Goodiwindi and Emerald. Two commercial varieties (PBA Boundary$^{\phi}$ and PBA HatTrick$^{\phi}$ in SQ and Kyabra$^{\phi}$ and PBA Pistol$^{\phi}$ in CQ) and a pre-release line CICA 0912, which was common across the regions, were sown at various row spacing. Significant crop management x environment effects were recorded with the highest yield of 4.7 t/ha recorded at Dalby where seasonal rainfall was favourable, in contrast to 1.9 t/ha at Goondiwindi where the crop faced prolonged end-of season drought.

In 2014 the chickpea trial was replicated at four locations, two at Dalby and two at Goodiwindi, to confirm or revise the initial results. A similar trial is laid out in mungbeans for the 2014-15 season.

In NSW, Dr Andrew Verrell is leading the agronomy research in winter pulses, where the work is concentrating on chickpea initially and will expand to include field pea and faba bean in the 2015 season.

There are two main components to the research program in NSW:

1. achieving yield improvement through agronomy where trials will investigate variety x density, nutrient omission, drought and heat adaptation, weathering, seed marking and row space effects
2. the impact of pulses in the cropping system where trials will investigate the 2–3 year sequence effect of pulses on cereals and cereals on pulses, particularly with regard to stubble management and phosphorus recovery.

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AUSTRALIA PREPARES FOR INTERNATIONAL YEAR OF PULSES 2016

Australian IYOP16 Steering Committee members (left to right) Georgie Aley (chair), Peter Wilson, Kristy Hobson (guest), Tim Edgecombe, Michelle Broom, Peter Semmler, Mary Raynes (secretary) and Sanjiv Dubey. Other committee members are: Dr Regina Belski, Rod Birch, Nick Poutney, Dr Chris Blanchard, Angus Woods, Lachie Seears, Paul Meibusch and Helen Ward.

by Cindy Benjamin

The pulse industry around the world is getting ready to take centre stage in 2016 for the United Nations declared International Year of Pulses (IYOP16).

Such an opportunity demands enormous commitment from all sectors of the industry and a high level of coordination and preparation.

Australia is pulling its weight with an Australian Steering Committee in place to formulate plans and direct activities under each of the five internationally-agreed themes—Food and Nutrition Security, Creating Awareness, Production and Sustainability, Trade and Market Access, and Health, Nutrition and Food Innovation.

IYOP16 is a launch pad for several long-term and ambitious activities to meet targets in each theme. In Australia the focus will be on raising Australia's profile as a producer of quality pulses while increasing the domestic demand and consumption of pulses to meet the Grains & Legumes Nutrition Council's recommendation for all Australians to 'eat legumes at least 2–3 times a week'. There is room to greatly increase production in Australia and to develop new domestic and export pulse markets.

Earlier in 2014, Ms Georgie Aley was appointed as the global thematic chair for one of the five IYOP16 themes. Ms Aley is the Managing Director of the Grains & Legumes Nutrition Council and a Non-Executive Director of Pulse Australia. She will chair the international 'Creating Awareness' theme as well as being chair of the Australian Steering Committee.

Ms Aley sees huge potential to drive awareness of the benefits of pulses through the IYOP16. "The IYOP16 represents a wonderful opportunity to make a real difference to the future of the food industry and the health and well-being of consumers around the world," she said.

"The IYOP16 Australian Steering Committee will actively engage with the Australian pulse community and value chain to influence the planning and implementation of the program. We want to ensure, where feasible, that interests of the entire Australian pulse community are represented," she said.

Other global thematic chairs are Syria's Dr Mahmoud El-Solh (Food Security and Nutrition theme), Canada's Mr Gordon Bacon (Health, Nutrition and Food Innovation theme) and France's Dr Noel Ellis (Productivity and Sustainability theme). At the time of writing there had been no appointment for global thematic chair for 'Market Access and Stability' committee.

Pulse Australia CEO, Tim Edgecombe is a member of both the global 'Market Access and Stability' and 'Productivity and Sustainability' theme committees. Michelle Broom, Nutrition Program Manager at the Grains & Legumes Nutrition Council, is a member of the global 'Health, Nutrition and Food Innovation' theme.

In October the thematic chairs, including Ms Aley, met in Rome, Italy to refine the work plans of the global committees and agreed on a range of global projects totalling over US $8 million.

A consumer-oriented website promoting the International Year of Pulses will be developed to provide a focal point for activities in the lead-up, during and beyond 2016. An international recipes database is the next major initiative that will help generate interest and increase consumer understanding of the versatility of pulses and their uses in cooking, along with showcasing national signature dishes from around the world.

The Australian Steering Committee is planning a national competition in early 2015 to choose the Australian Signature Dish, a dish that reflects the national cuisine and highlights the innovative capacity of pulses as an ingredient. The winning iconic meal will be showcased on the global stage by July 2015.

The Australian Steering Committee held several planning sessions and an industry workshop in 2014 to assist in formulating plans for IYOP16. Further industry workshops and stakeholder engagement will occur in early 2015 to advance Australia's position and opportunities for the IYOP16.

MORE INFORMATION: www.iyop.net

PBA Capacity Building

In 2014 Pulse Breeding Australia (PBA) selected four projects to support through the PBA Capacity Building Program. The program aims to support high quality research in areas of strategic relevance to PBA, train postgraduate students to increase the Australian capability in pulse research, upskill current pulse researchers, direct high calibre undergraduate students into pulse breeding research and target people and project combinations to ensure capacity is developed for PBA succession planning.

The four projects, which began in July 2014, are:

1. Increasing lentil tolerance to heat waves using genetic solutions—conducted by PhD student Miss Audrey Delahunty under the supervision of Drs Jason Brand and James Nuttall, DEPI and Dr Marc Nicolas, Melbourne University.
2. Physiology of yield determination in chickpea (*Cicer arietinum* L.): Critical period for yield determination, patterns of environmental stress and competitive ability—conducted by PhD student Mr Lachlan Lake under the supervision of Associate Professor Victor Sadras, SARDI, Dr Jeff Paull, University of Adelaide and Dr Kristy Hobson, NSW DPI.
3. Increasing pulse plant pathology capacity via a project to clarify the interaction of waterlogging and ascochyta in lentils and faba beans—an honours student project to be supervised by Dr Peter Johnson and Dr Karen Barry TIA/University of Tasmania.
4. Developing whole-genome sequence resources for foliar fungal pathogens of lupin—to be supervised by Dr James Hane.

(Source: PBA News Winter 2014)

Hurricane blows away records

by Alistair Lawson

A newly-developed lentil variety is enjoying unprecedented levels of popularity with growers thanks to its herbicide tolerance and disease resistance traits.

PBA Hurricane XT$^{\phi}$ (Hurricane)—a small red lentil variety bred by Pulse Breeding Australia—is the first widely adapted, herbicide tolerant lentil released in Australia. It is tolerant to imazethapyr at label rates and has improved tolerance to flumetsulam and to residual levels of sulfonylurea and imidazolinone herbicides.

Dr Jason Brand, Senior Research Agronomist – Pulses at the Victorian Department of Environment and Primary Industries and leader of the Southern Pulse Agronomy team, said the tolerance of Hurricane to herbicides, particularly Group B chemicals, was rigorously investigated.

The aim of the Grains Research and Development Corporation-funded research was to gauge the variety's response to Group B herbicides on a range of soil types and rainfall zones in the key production areas of South Australia and Victoria.

"There were trials looking at Hurricane's tolerance to imazethapyr, which was applied either post-sowing pre-emergent or in-crop at the four node stage, which linked in with work done by other providers involved in the registration process of the chemical," Dr Brand said. "We also completed work looking at its tolerance to a range of other imidazolinone products. We had four different imidazolinone herbicides, including imazethapyr, at a range of application rates and looked at its relative tolerance to those four different chemicals. It wasn't about gaining registration, but rather about understanding Hurricane's tolerance to residues."

Hurricane builds on the herbicide tolerance of PBA HeraldXT$^{\phi}$ (Herald), which was more adapted to medium to high rainfall zones and not as well adapted to drier conditions. Herald is a later maturing variety, which suits different locations in South Australia, but does not grow as well in all parts of Victoria. Trials have found Hurricane to yield 5–12 per cent better than other small red lentil varieties, such as Herald, across a range of conditions and soil types.

"Long-term, across a range of soil types and rainfall zones, Hurricane has been consistently good," Dr Brand said. "In drier Mallee zones, that's when it will have a big yield advantage over Herald and Nipper because both of them are later flowering, whereas Hurricane moves back to early-mid type maturing varieties. Hurricane also has moderate resistance to ascochyta blight, giving growers another option in disease control."

There was also rapid uptake of Herald when it was released and Dr Brand was not surprised by Hurricane's popularity. He said it reflected the need for new weed management options in farming systems.

"This takes a bit of risk away for growers keen to put the highest value crops in the system and still maintain weed control. The Yorke Peninsula is one of the biggest uptake areas, and growers there are highly reliant on lentils in the system simply through the value of crop. If they can grow a 3 t/ha lentil crop at $500/ha, they are dealing with a pretty profitable crop."

Dr Brand said Herald and Hurricane were the first steps into herbicide tolerance in all pulses, with similar tolerances likely to come in faba bean and chickpea in the future.

"There's new lines coming through the breeding program all the time. Hopefully we'll get alternative tolerances. We have already released varieties that are higher yielding than Hurricane but don't carry the same herbicide tolerance. The breeders have done a great job in terms of improving yields and general adaptation—the future is about continuing to combine those traits."

Hurricane has had the biggest first-year uptake in growing area of any other PBA lentil variety, according to Janine Sounness, Commercial Manager, PB Seeds.

Ms Sounness said PB Seeds sold 950 tonnes of Hurricane seed in the lead-up to the 2014 growing season—probably more than double the quantity of any other lentil variety in its first year of release.

Of the 170 thousand ha sown to lentil in 2014, 20–25 thousand ha was sown to Hurricane.

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Know more, grow more pulses: GRDC GrowNotes

In March 2014 the Grains Research and Development Corporation (GRDC) launched a comprehensive set of crop information modules, the GRDC GrowNotes.

James Clark, GRDC northern panel chair said the GrowNotes are an entirely new initiative for the organisation and for the first time provide a one-stop shop for northern region trial results and recommendations.

"Having said that, the GrowNotes build on extension media of past and present, from crop management notes to YouTube," Mr Clark said.

"The GrowNotes are digital documents, available online, so they are able to use the very best e-publishing technology available to make the information easy to find and navigate."

Since the launch of the first three modules, wheat, barley and durum, GrowNotes for three pulse crops have been published.

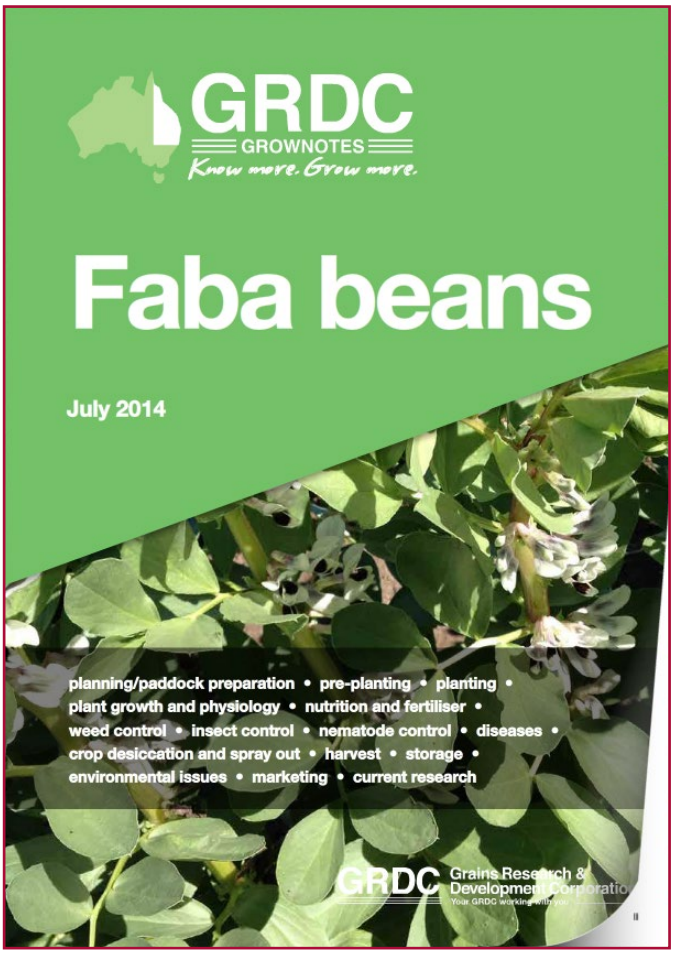
The faba beans, mungbeans and chickpeas GrowNotes provide ready access to information that will help growers adopt best practices and increase production and profit.

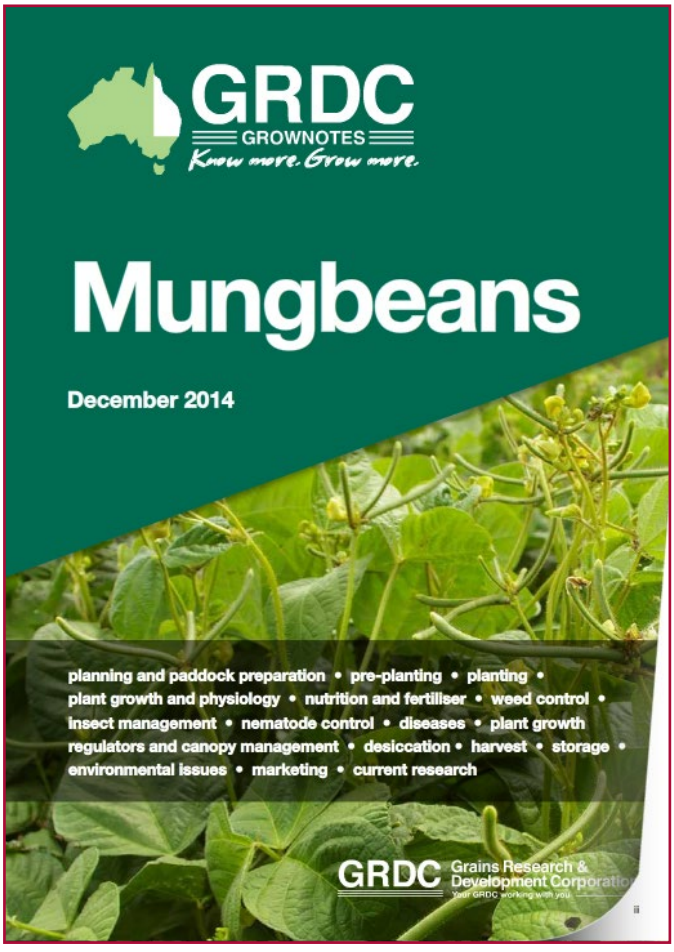
Pulse Australia national development manager, Gordon Cumming said the GrowNotes included a large amount of information that Pulse Australia had gathered over several years, and were an excellent resource for growers and agronomists to refer to if a problem arises or they are growing a certain pulse crop for the first time.

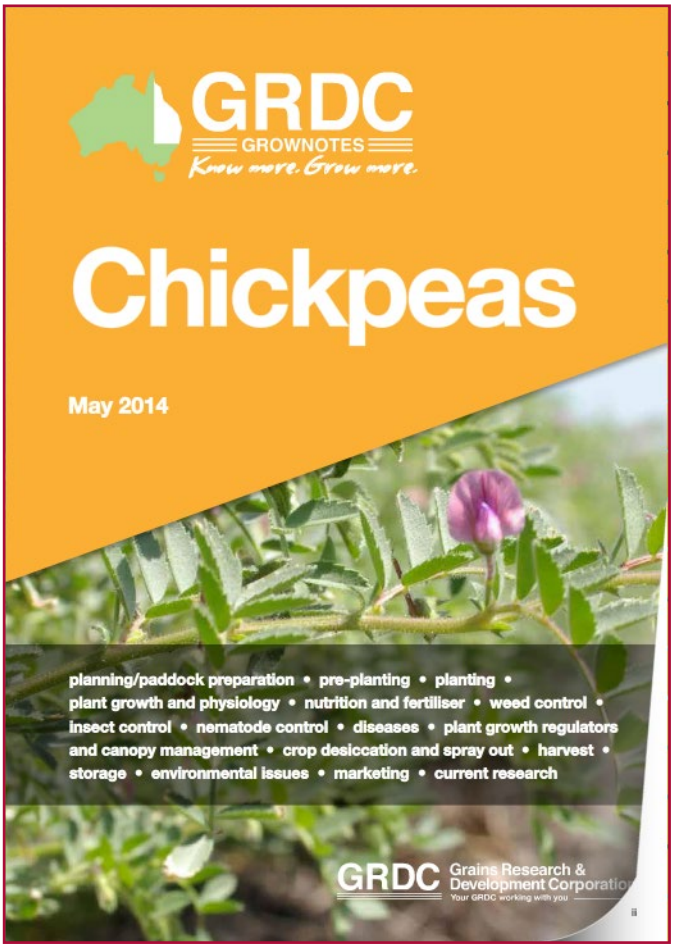
"I encourage growers and advisors to use the GrowNotes as a ready reference and to attend the Best Management Practice training courses that Pulse Australia offers in regional centres," he said.

The training courses offer growers and their advisors the opportunity to interact directly with researchers, marketers and experienced agronomists about region-specific opportunities and production issues (to register for training courses in 2015 see page 15).

Access the GRDC GrowNotes via www.grdc.com.au/GrowNotes.







3 lentils, 1 faba bean & 1 mungbean for 2015

In 2014, Pulse Breeding Australia (PBA) and the National Mungbean Improvement Program released five new pulse crop varieties—three lentils, one faba bean and one mungbean.

The three lentil varieties are adapted to the existing lentil growing areas of southern and western Australia and offer improved yield and disease resistance. The new faba bean variety will set a new benchmark for yield in the production areas in southern Australia and is resistant to ascochyta blight. The new mungbean variety replaces Celera (released 1969) and Green Diamond (released 1997), reinstating grower and market demand for small seeded Australian mungbean.

The Australian pulse industry is very fortunate to have two dedicated plant breeding programs—Pulse Breeding Australia for the winter pulses and the National Mungbean Improvement Program (NMIP).

The focus of the Pulse Breeding Australia (PBA) breeding programs is to deliver pulse cultivars with:

- regional adaptation
- high yield
- superior resistance to diseases (e.g. ascochyta and bacterial blight, botrytis grey mould, anthracnose and chocolate spot)
- outstanding quality parameters for mainstream and special-purpose end-users
- improved abiotic stress tolerance (e.g. to herbicide, boron and salt).

Together with its commercial partners, PBA has streamlined variety release to make new varieties available to Australian growers up to three years faster than traditional variety release methods.

Since its inception in 2003 the NMIP has improved yield and reliability for the industry with the release of Crystal$^{\Phi}$ and Satin II$^{\Phi}$ in 2008 taking grower and industry confidence to a new high.

Increased planting area (from 45 000 to 66 000 ha) and production (65 000 t) has followed and will continue as new varieties with improved disease resistance come to market.

Pulse Australia publishes variety management packages (VMP) for each new variety, providing specific agronomic and marketing information to assist with variety selection and crop management. Click on the variety to download the relevant VMP.

PBA Samira$^{\Phi}$ new benchmark southern faba bean variety

- Highest yielding faba bean available for the southern region that has wide adaptation and is very responsive to high yielding situations.
- Excellent ascochyta blight resistance (including to the new strain recently identified in the mid-north of South Australia).
- Improved chocolate spot and rust resistance compared to Fiesta VF and Farah$^{\Phi}$.
- Vigorous plant with good stem strength.
- Medium sized seed, similar to Fiesta VF and Farah$^{\Phi}$, suited to the Middle East markets.

An End Point Royalty (EPR) of $3.85 per tonne (GST inclusive) applies, which includes breeder royalties, applies upon delivery of this variety. Seed is available from the commercial partner Seednet.

PBA Greenfield$^{\Phi}$ high yielding disease resistant medium-sized green lentil

- A broadly adapted variety, well suited to medium rainfall lentil growing regions of southern and western Australia.
- Highest yielding green lentil variety in Australia with a long-term average yield advantage over Nugget and Boomer$^{\Phi}$ of around 10 per cent.
- Moderate resistance to ascochyta blight and botrytis grey mould.
- Improved tolerance to soil salinity, similar to PBA Flash$^{\Phi}$ and PBA Bolt$^{\Phi}$.
- Small broadleaf weed seeds readily removed from harvested sample.
- Suited to human food market as an emerging market class for Australian growers. Segregated on-farm storage is likely to be required.

PBA Greenfield$^{\Phi}$ will be open marketed with an End Point Royalty (EPR) of $5.50/t (incl. GST), applied upon delivery. Seed is commercialised through PBSeeds and available from 2014.

PBA Giant(Φ) high yielding large green lentil

- Largest seed size Australian green lentil variety (average diameter of 5.8 mm) offering improved yield over Boomer(Φ) in Victoria (5–10% on average) and similar yield in South Australia.
- A broadly adapted variety, best suited to medium rainfall lentil growing regions in southern and western Australia.
- Good early vigour, similar to PBA Ace(Φ) and Boomer(Φ) and improved shattering resistance compared to Boomer(Φ).
- Moderately resistant to ascochyta blight.
- Improved tolerance to soil boron, similar to PBA Jumbo(Φ), PBA Flash(Φ) and PBA Bolt(Φ).
- Well suited to the removal of small broadleaf weed seeds from the harvested sample.
- Suited to the human food market with excellent prospects in the domestic market, to replace imported product, and for export. Segregated on-farm storage is likely to be required.

PBA Giant(Φ) will be open marketed with an End Point Royalty (EPR) of $5.50/t (incl. GST), applied upon delivery. Seed is commercialised through PBSeeds and available from 2014.

PBA Jumbo 2(Φ) high yielding disease resistant large red lentil

- A higher yielding replacement for PBA Jumbo(Φ) and Aldinga (average yield 9–13% higher than PBA Jumbo(Φ)) in all areas with seed size similar to PBA Jumbo(Φ) and Aldinga.
- Mid-maturing, broadly adapted variety that is resistant to ascochyta blight and botrytis grey mould.
- Suited to early sowing to maximise yield with improved early vigour and improved lodging resistance over PBA Jumbo(Φ) and Aldinga.
- Tolerance to soil boron is similar to PBA Jumbo(Φ), PBA Flash(Φ) and PBA Bolt(Φ).
- Well suited to the removal of small broadleaf weed seeds from the harvested sample.
- Suits the human food market (consumed whole or split) for large-sized red lentil, fitting export markets that have traditionally bought the PBA Jumbo(Φ) and Aldinga varieties. Segregated storage is required.

PBA Jumbo2(Φ) will be open marketed with an End Point Royalty (EPR) of $5.50/t (incl. GST), applied upon delivery. Seed is commercialised through PBSeeds and available from 2014.

Celera II-AU(Φ) a disease resistant small-seeded shiny mungbean

- Broadly adapted to existing production areas of northern NSW and southern Queensland and suitable for both spring and summer planting.
- Yield similar to Green Diamond in disease-free situations.
- Improved tan spot resistance and similar powdery mildew resistance compared to Green Diamond.
- Outperforms all current varieties under high halo blight disease pressure.
- Earlier flowering and maturity compared to large green mungbean varieties.
- Niche variety, potentially replacing Green Diamond, with a limited market size. Grown for niche markets in many European and Asian countries and for some splitters and millers that prefer small green mungbean—consult with marketer before planting.

Celera II-AU(Φ) is protected under Plant Breeder's Rights (PBR) legislation. A Seed Royalty, which includes breeder royalties, applies at the point of sale. Seed is available from your local Australian Mungbean Association (AMA) member or seed re-seller.

Vetches

The National Vetch Breeding Program (NVBP), supported by GRDC, SARDI, SAGIT and Seedmark, has released two new common vetch (*Vicia sativa*) varieties for 2015.

Common vetch can be fed to ruminants as grain, hay or silage. Grain can be used in pig feed rations at up to 20% of the diet. It can be sown as a pure pasture or in cereal mix, both green and dry for grazing stock or used in a crop rotation to increase organic matter in the soil and put nitrogen back into the soil through nitrogen fixation.

Timok(Φ) seed is commercialised through Seed Distributors and available from 2016.

Volga(Φ) seed is commercialised through Heritage Seeds and available from 2016.

Timok(Φ) high yielding, highly rust resistant common vetch

- Moderately resistant to ascochyta blight but susceptible to botrytis.
- Good early establishment.
- Maturity between Rasina and Morava (100–105 days seeding to full flowering).
- Best adaption for grain production in rainfall areas >300 mm/yr.
- Dry matter production 19% higher than Morava in low to medium rainfall regions (330–380 mm).

Volga(Φ) high yielding, highly rust resistant common vetch

- Earlier in maturity by 7–12 days than Rasina (90–100 days from seeding to full flowering).
- Moderately resistant to ascochyta blight.
- Very good early establishment.
- Higher yielding in both grain and hay than current varieties in < 380mm rainfall.
- Bigger seeds and more readily digested than Rasina vetch.
- Well adapted to short season areas.

Building phytophthora root rot resistance in chickpea

Will a wild relative come to the rescue?

Chickpea Phytophthora Research Officer, Sean Bithell, is leading a project to better understand the ***modus operandi*** of the PRR pathogen and to collaborate with the chickpea breeding program to breed more resistant varieties for growers to use in high disease-risk situations.

by Cindy Benjamin

The annual cost of phytophthora root rot in chickpea is estimated at $8.2 million, but without the current cultural controls ($5.3 million) and moderately resistant varieties ($3.6 million) the annual losses would be about $17.1 million.

Improving the disease resistance of new varieties while maintaining productivity could save the industry a large portion of the $8.2 million lost annually.

Phytophthora root rot is limiting the potential growth of the industry in the northern and southern growing regions of Australia and is a motivating force behind a 5-year GRDC-funded project involving researchers from NSW Department of Primary Industries, Department of Agriculture, Fisheries and Forestry (Qld), University of Adelaide and University of Queensland.

Chickpea Phytophthora Research Officer with NSW Department of Primary Industries, Sean Bithell, is leading the project that aims to better understand the *modus operandi* of the pathogen and to collaborate with the Pulse Breeding Australia (PBA) chickpea program to breed more resistant varieties for growers to use in high disease-risk situations.

Mr Bithell says the pathogen that causes phytophthora root rot (PRR) in chickpea is endemic and widespread in southern Queensland and northern NSW. Although metalaxyl fungicide is registered as a seed treatment for PRR it is not used commercially because it is expensive and does not provide season-long protection. The recommended management of PRR is to avoid planting chickpeas into high risk paddocks and to plant the most resistant variety if there is potential for PRR to limit yield.

"Chickpea varieties to date have limited resistance to infection by the pathogen, *Phytophthora medicaginis*, which survives between seasons on the roots of infected chickpea volunteers, lucerne and native medics and as resistant structures (oospores) in the soil," he says.

Current commercial varieties differ in their resistance to *P. medicaginis*, with Yorker$^{\phi}$ having the best resistance (MR), PBA HatTrick$^{\phi}$, Flipper$^{\phi}$, Jimbour, Kyabra$^{\phi}$ having a lower level (MR-MS) and PBA Boundary$^{\phi}$ and most kabuli varieties having the least resistance (S). PBA Boundary$^{\phi}$ and kabuli varieties should not be grown in paddocks with a history of PRR, lucerne, medics or other hosts.

"Previous work by NSW DPI chickpea breeder, Ted Knights, screened wild relatives of chickpea to identify any that could contribute disease resistance to the breeding program," says Mr Bithell. "That extensive screening identified a wild relative, from the Transcaucasia region that has some useful resistance to PRR."

"The wild relative, *Cicer echinospermum*, has several undesirable traits, such as small spiny seeds and a prostrate plant architecture, which we do not want to bring into any new breeding lines," he says.

Since the identification of this wild relative the breeding program has naturally crossed the wild relative with adapted chickpeas and developed new lines through crossing and back-crossing with current varieties and elite breeding lines to develop new, advanced lines in the PBA breeding program.

As new lines are produced they will be challenged with the pathogen and assessed for susceptibility to PRR.

A major component of the new project involves disease screening and molecular work on lines from crosses between phytophthora root rot susceptible and resistant material (including wild relative crosses). Researchers from the University of Adelaide will use DNA technology to identify DNA sequences (molecular markers) that are associated with resistance to PRR.

"Identifying the molecular markers will help speed up the selection process as plant breeders can exclude lines that do not possess the required markers, and concentrate on those most likely to possess useful levels of PRR resistance," says Mr Bithell.

As Mr Bithell explains, one of the most difficult parts of plant breeding is 'stacking' desirable traits into the one variety. Using genomic technology helps plant breeders to identify potential parents that are most likely to produce crosses possessing a number of desirable traits without carrying any strongly undesirable traits.

"One important example is that high levels of resistance to ascochyta blight and phytophthora root rot are yet to come together in the one variety. However both diseases are major causes of crop losses in the northern cropping region," he says. "This means that having a variety with improved resistance to both pathogens would be highly beneficial to the industry."

In the 5-year timeframe of the project the expectation is that researchers will identify the molecular markers associated with PRR resistance and deliver improved germplasm to the PBA breeding program. The resulting advanced breeding lines will be evaluated in the National Variety Testing (NVT) trials and checked for their adaptation in the target environment.

PRR distribution and testing

Phytophthora medicaginis survives as thick-walled oospores that develop in infected roots of chickpea and some other host plants, including lucerne and annual medics. When the soil is saturated with moisture, the oospores germinate to produce sporangia, which release zoospores that swim to and infect living chickpea roots. The pathogen is spread by movement of infected soil and by zoospores in moving water.

P. medicaginis has not been recorded in Western Australia and is rare in the southern grains region, but seasonal conditions in one-third of years will support the disease in the northern growing region. In those years approximately one-third of the sown crop is likely to be affected, reducing yield by up to 30 per cent in these years.

Average yield losses are 4.8 per cent in the northern region and 9 per cent in the southern region. The average cost of PRR in Australia is currently estimated at $28/ha, representing a $8.2 million loss to the industry.

The geographical distribution of *P. medicaginis* in Australia is not known so another aspect of this project is to collect soil from across the growing regions where there is a history of the disease or where PRR problems have been suspected.

The aim is to identify as many different isolates of the pathogen as possible and to develop a soil test that can be used to determine if the pathogen is present in a paddock before planting chickpea.

Waterlogging v PRR

The effects of waterlogging and PRR can easily be confused in the field. There are differences though, and it is necessary to determine the cause before undertaking remedial action such as land levelling.

Waterlogging	PRR
roots die from lack of oxygen	the pathogen consumes the roots
plants are most susceptible during flowering and early pod fill	can affect plants of any age
symptoms develop within 2 days of flooding	symptoms take at least 7 days to develop after wet weather
roots do not rot immediately after the symptoms appear	roots begin breaking down immediately after infection
affected plants are not easily pulled from the soil after symptoms appear	affected plants are easily pulled from the soil

Correcting surface and sub-surface drainage will overcome waterlogging problems. Managing PRR risk involves avoiding high risk paddocks (based on previous experience and paddock history) and choosing the most resistant varieties.

"The literature suggests that the PRR pathogen can survive for a long time in the soil," says Mr Bithell. "Using tighter rotations can increase the disease risk by enabling the PRR population to increase in the soil, making a soil test a very valuable tool for growers."

"We also need to be able to test all new breeding lines against isolates of the pathogen collected from a wide geographic range to be sure that the new varieties will exhibit resistance in the desired growing regions," he says.

The PreDicta B® DNA extraction test, available from the South Australian Research and Development Institute (SARDI), is commercially available to assess soil samples for several soil-borne pathogens.

The test for PRR is in the developmental stage and is currently being validated.

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Heavily infected susceptible variety (Sonali) surrounded by breeding lines (crosses with the wild relative) that are not showing PRR symptoms, despite the area being inoculated with the pathogen at sowing. Trial site at Warwick, Qld.

Soil health and crop nutrition benefits proven:

Irrigated cotton and faba bean rotation

by Tim Weaver and Cindy Benjamin

For almost 20 years Dr Ian Rochester and the crop nutrition team at the Australia Cotton Research Institute (ACRI) near Narrabri, NSW have been monitoring the effect of a variety of crop rotations on soil health and cotton crop performance.

Early results indicated that including a legume in an irrigated cotton rotation was beneficial on several fronts. The legumes that fit best in rotation with cotton and contribute the most fixed nitrogen are vetch, grown as a green manure crop in the winter between cotton crops, and faba bean, sown the winter after cotton harvest then fallowed for 10–12 months before planting cotton again. Legumes have consistently provided greater soil benefits than wheat crops sown between cotton crops.

Dr Rochester's earlier trials have shown that both these legume crop options can eliminate the need to apply nitrogen fertiliser for the following cotton crop. The added economic advantage of faba beans is the value of the harvested grain, which can be removed while still leaving sufficient nitrogen in crop residue (stubble and roots) to supply most of the requirements of the following cotton crop.

The 16 irrigated faba bean crops grown at ACRI, Narrabri between 1995 and 2012 yielded 2.3 t/ha on average (up to 4.4 t/ha) and returned an average 131 kg N/ha after grain harvest. In addition, the root systems of faba bean plants exude organic acids that improve subsoil structure, feed the microbes and add 10 per cent more carbon to the soil than wheat crops did in the trial. Dr Rochester's research has demonstrated that including faba bean in the rotation can lower the subsoil sodium levels, which also improves the soil structure and encourages cotton plant roots to explore further down the soil profile.

Recent research indicates that faba bean have benefitted from phosphorus fertiliser placed deeper than 15 cm, especially when Colwell-P levels are below 10 mg P/kg soil. The P fertiliser is used more efficiently and the residual phosphorus fulfills the needs of the following cotton crop.

To grow high biomass faba bean crops of about 5 t biomass/ha requires one or two irrigations most years in the cotton districts of northern NSW. Rain-fed faba bean grown in rotation with irrigated cotton will still make significant contributions to the nitrogen budget and provide subsoil fertility benefits, although their contribution to farm income is likely to be less than an irrigated crop.

Crops that produce between 2 and 7 tonnes dry matter per hectare above ground can fix 37 kg N per tonne DM, or 75–260 kg N/ha, before grain removal.

When irrigation water is limited, as it has been for 15 years or more, many growers have chosen not to irrigate their rotation crops and some have opted to grow wheat rather than legumes. This has increased the reliance on nitrogen fertiliser and many cotton fields have not benefitted from the soil conditioning effects of faba beans.

About 231 500 ha of cotton was sown in NSW for the 2013–14 cotton season, producing approximately 2.2 million bales. It is estimated that five per cent of cotton country, approximately 11 000 hectares, was sown to faba beans following the good rain that fell in March in most districts.

PBA Warda$^{\Phi}$ is the recommended faba bean variety for the Namoi Valley irrigation areas.

The PBA Warda$^{\Phi}$ Variety Management Package (VMP) provides specific management recommendations and can be found on the Pulse Australia website www.pulseaus.com.au

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Tim Weaver (centre), Pulse Australia and NSW DPI industry development manager, Todd Farrer (left), former manager Findley Farms Pty Ltd, and James Pursehouse (right) sales agronomist, Cotton Growers Services inspect a promising crop of faba bean on Findley Farms' Wee Waa property.

Findley Farms' cotton feeds on faba N

Cindy Benjamin

Faba beans have found a permanent place in the crop rotation on Findley Farms west of Wee Waa, where they are a valuable cash crop that provides additional nitrogen for the following cotton crop.

Former farm manager, Todd Farrer, says they have had good results with Doza faba beans over the last six or more years. "The 2014 season started well with six inches of rain falling around planting time that saw the crop through to flowering," he says. "One irrigation in July was enough to finish the crop."

Findley Farms is primarily in the cotton business, with four farms in the Wee Waa area. Other winter crops grown on the farms include wheat and chickpea to spread production and price risks.

Mr Farrer says that care is required to reduce the risk of verticillium wilt affecting cotton crops on the farms. With both chickpea and faba bean hosting the disease, wheat is grown to provide a disease break.

"In 2014 our faba bean area was less than usual due to changes in the rotation plan but the 50 ha we planted still contributed positively to overall returns," says Mr Farrer. "Average faba bean yields from the farms is 3.5 t/ha and the 2014 crop performed well on stored soil moisture and one irrigation, yielding 3 t/ha."

Most of the soils on the farms along Pian Creek are fertile grey self-mulching soils with loamy characteristics that have had gypsum applied over many years. Faba bean are well suited to this soil type and have a very beneficial effect on soil structure.

Mr Farrer applies one mancozeb spray to protect the crop from foliar fungal diseases such as chocolate spot. Cut worms and aphids also generally require control treatments. Insect monitoring tracks population size and assesses any leaf damage by helicoverpa, but faba bean can tolerate significant foliar damage with minimal yield loss.

"We control heliothis grubs at podding if necessary as they can cause economic damage to the pods and the developing grain," he says. "Late application is a softer environmental option and gives the beneficials the best chance of suppressing insect pests."

A well-grown faba bean crop is expected to contribute a significant amount of nitrogen to the next crop. Mr Farrer says discing the stubble in at the end of the season releases the nutrients, including nitrogen, into the soil ready for the following cotton crop that is planted four to five months after the faba bean harvest.

"This year we forward sold about half the expected crop and sold the rest straight off the header," he says.

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Counting the cost of seed impurity

DPI NSW senior pathologist, Dr Kevin Moore is encouraging northern region growers to segregate chickpea varieties stored on farm or to purchase seed from authorised seed re-sellers.

by Cindy Benjamin

Bringing disease risk under control in chickpeas has been a major driver in the industry's plant breeding program and has under-pinned grower confidence in the crop.

Varieties released after 2005 have significantly better resistance to ascochyta blight than earlier varieties and this characteristic alone has increased chickpea profitability and drastically reduced production risk.

NSW DPI research funded by GRDC suggests the difference in fungicide costs between a susceptible variety, such as Jimbour, and a moderately resistant variety, such as PBA HatTrick(D) , is around $30 000 across a 500 ha planting in a season that is favourable for the pathogen.

So, when outbreaks of ascochyta blight occurred in 2013 in several crops, believed to be PBA HatTrick(D), there was concern that grower confidence in the variety had been breached.

There were initial fears that a mutation of the ascochyta blight pathogen, *Phoma rabiei*, may have occurred, but researchers ruled this out as the cause of the disease outbreaks in these crops.

After investigation of the affected crops, it was found that they were all grown using grower-retained seed. Batches of seed had been acquired, all supposed to be PBA HatTrick(D), but when the crops were established some batches were clearly a different variety.

NSW DPI Senior pathologist, Kevin Moore says the problem of varieties becoming mixed in on-farm storage or being incorrectly identified has been known since 2011 and seems to be getting worse.

Dr Moore says certified seed is guaranteed true to type and growers are assured that the seed they purchase will have the variety characteristics that they expect.

"This is particularly important with disease resistance because if the variety is not known for certain then growers will need to assume that the crop is susceptible to disease and treat it accordingly, potentially applying unnecessary fungicide sprays," he says.

"This is because all varieties are susceptible to ascochyta blight during podding," explains Dr Moore. "If there is not sufficient disease control implemented during the vegetative stage then the amount of inoculum in the field is likely to cause more infection during podding than would be expected in a moderately resistant variety like PBA HatTrick(D)."

In situations where seed lots are contaminated, even with a small proportion of seeds from a different variety, there is a risk that inoculum will build up on susceptible plants, putting undue pressure on the resistance genes in the moderately resistant plants. The multiplier effect of seed can see the percentage of contaminated seed increasing in successive generations of grower-retained seed.

Pulse Australia national development manager, Gordon Cumming says this can lead to marketing problems if the grain contains a mixture of varieties that may not meet quality standards for specific markets.

"Seed acquired from sources outside the certified seed program carry no purity guarantee and growers forfeit their legal rights to compensation if the seed is not true to type," he says. "Such a transaction also short-changes the plant breeding program of the funds generated through end-point royalties."

Genetic screening of seed is not commercially available so the only way to be sure that you are buying and planting a particular variety is to source the seed from an authorised seed re-seller.

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Pulse crops to tackle weeds head-on

by Cindy Benjamin

Pulse plant breeding and agronomy research efforts over the last 20 years have significantly improved pulse varieties and their management in Australia. Even so, NSW DPI research agronomist, Dr Eric Armstrong wants more.

"We want to change the perception that pulses are a weak link in the farming system for weed control," he says. "Our research is focused on increasing the weed control options in pulses, making them a strong link."

"To maximise farm income opportunities we want to breed pulse varieties that help control weeds without compromising grain yield," says Dr Armstrong.

"One of our major initiatives is to screen the different winter pulses for early maturing lines that can maintain yield and take advantage of croptopping or desiccation as a critical weed control tool," he says. "In field pea the idea is to sow later, croptop or desiccate, then harvest early. This is a strategic three-pronged attack on weeds—before, during and at the end of the pulse crop phase."

The broader spectrum of herbicides registered for pulses provides additional weed control options in rotations. Additionally, herbicide resistant pulses such as imi-tolerant lentil are already commercially available.

Dr Armstrong says legumes provide unique benefits, including nitrogen fixation, which no other plant group can contribute to the farming system. He and other researchers in the southern cropping region are becoming increasingly concerned about the current over-use of canola as a break crop in cereal crop rotations, primarily from a pest and disease management perspective, but also through the lost opportunities to build soil fertility.

In the past, compromised management and weed escapes in longer-season varieties have given pulses a bad reputation and some growers have chosen instead to brown manure or fallow their paddocks to gain the upper hand on weeds.

"Although there are significant benefits in green or brown manuring a pulse crop it is rarely economical across the crop rotation," he says. "This is because growing two cash crops and a manure crop, or fallow, rarely earns as much income as three consecutive cash crops, even though the crop grown following a manure crop is likely to produce higher yield."

This work complements a long history of pulse research at the Wagga Wagga Agricultural Institute that has concentrated on fine-tuning legume varieties and management practices to suit the acid soils and mixed farming systems unique to southern NSW. This work is conducted in close partnership with the national breeding program, Pulse Breeding Australia, and pulse agronomy programs across Australia.

"Field pea is one of the better pulses for controlling weeds," Dr Armstrong added. "Largely because this species is normally sown late, has rapid winter growth and matures relatively early."

The recently released varieties, PBA Pearl$^{\Phi}$, PBA Percy$^{\Phi}$ and PBA Oura$^{\Phi}$, are early flowering and maturing, making them potential candidates for croptopping, but they were not released with this management strategy in mind.

Dr Armstrong says a range of very early maturing PBA field pea breeding lines and commercial cultivars are being evaluated at Wagga specifically for croptopping and desiccation. SW Celine$^{\Phi}$ and several breeding lines proved very suitable during 2014 trials and these results justify their cultivation for weed control alone. He added that early maturing faba bean, lentil and lupin varieties also show good promise for croptopping to assist with integrated weed control..

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Dr Eric Armstrong, NSW DPI research agronomist (left) demonstrates the use of Greenseeker technology in the weed management crop rotation trials at Wagga Wagga Agricultural Institute to Pulse Australia industry development manager, Tim Weaver.

More biomass = More N

Nitrogen fixation in chickpea and mungbean

by Cindy Benjamin

Maximising the residual nitrogen benefit of chickpea and mungbean crops is central to the overall value of including pulses in a crop rotation.

Growers and researchers understand the importance of inoculating seed with rhizobia and achieving effective nodulation but there are other aspects of crop agronomy that can influence the overall nitrogen budget for these pulse crops.

Dr Nikki Seymour, senior soil microbiologist with Department of Agriculture, Fisheries and Forestry, Queensland is currently studying the N-budgets of mungbean and chickpea crops grown at various row spacings.

"All nitrogen fixation data points toward the best growing pulse crops fixing the most atmospheric nitrogen," says Dr Seymour. "Some pulses leave more nitrogen in the soil than others but they can all improve the nitrogen efficiency of the rotation provided there is not too much nitrogen already in the soil, such as residual fertiliser from a previous crop or mineralisation from a long fallow."

In these circumstances, Dr Seymour suggests growing a non-legume crop to make better use of the available nitrogen.

"Low soil nitrate conditions are ideal for pulses because they increase the potential for the crop to fix nitrogen," she says. "Growing a high biomass crop in these situations will potentially maximise the nitrogen available for following crops."

Dr Seymour's research has demonstrated that, in general, more nitrogen is fixed if pulse crops are planted in narrower rows.

"Even when the plant density is the same for narrow and wide rows we see more nitrogen being fixed and left behind in the soil after a crop is grown on the narrower spacing," she says.

"It is thought that pulses grown at wider spacings do not access all of the moisture and nutrients between the rows and so do not necessarily benefit from the wider spacing like some other crops do."

Recent nitrogen budget field work in chickpea crops at Dalby and Goondiwindi, Queensland has shown the beneficial effect of narrow rows on crop biomass, per cent N derived from the atmosphere (%Ndfa) and total crop N fixed (see Table 1).

"Similar proportions of nitrogen are removed in the grain regardless of the row spacing so the overall N-budget is improved with greater accumulation of N under the narrow rows," says Dr Seymour. "At Dalby, we estimated that 59 kg of N/ha remained in the soil following the chickpeas grown at 0.25 m row spacing whereas only 23 kg N/ha was left after the chickpeas grown on 1 m row spacing. The effect is most obvious in regions and seasons that support high biomass production."

Dr Seymour's research also examined the effect of varieties on the N-budget at different row spacings (Figure 1). "What we found was that all three of the current chickpea varieties accumulated more N under narrow row spacing, as did all but one of the mungbean varieties tested," she says. "Satin II$^{\phi}$ appears to compensate for the wider spacing and was the only variety to achieve similar N-accumulation at both narrow and wide row spacings."

However, mungbeans generally do not leave high levels of nitrogen in the soil for future crops. In a separate trial Dr Seymour is screening the new mungbean germplasm in the plant breeding program to assess their genetic ability to fix nitrogen and their affinity with current rhizobia strains.

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Table 1. Reduction in N fixation and total amount of N fixed in chickpea (meaned across 3 genotypes) as row spacing in the field increases.

	Shoot dry weight (t/ha)		%Ndfa		Total crop N fixed (kg/ha)	
Row spacing (m)	Dalby	Goondiwindi	Dalby	Goondiwindi	Dalby	Goondiwindi
0.25	9.89	4.75	61.0	39.2	187.3	62.8
0.5	9.25	4.23	55.8	33.9	161.9	48.0
1.0	7.96	3.59	47.6	35.4	122.5	42.0
LSD (P=0.05)	1.12	0.67	7.0	n.s.	31.5	16.3

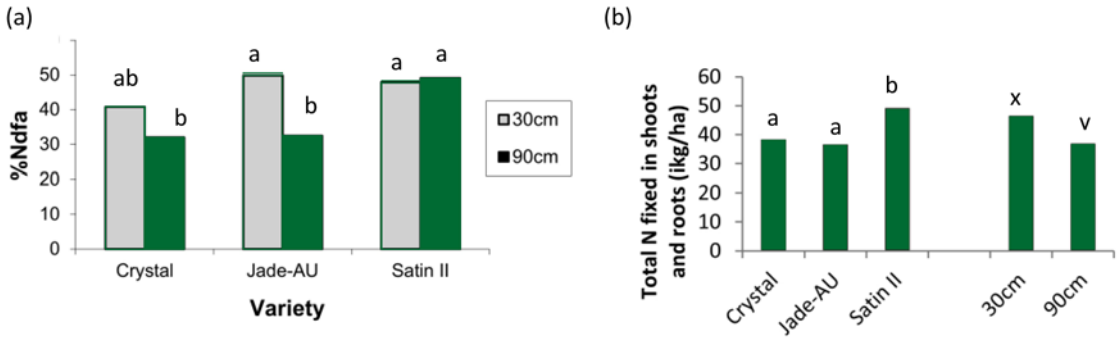
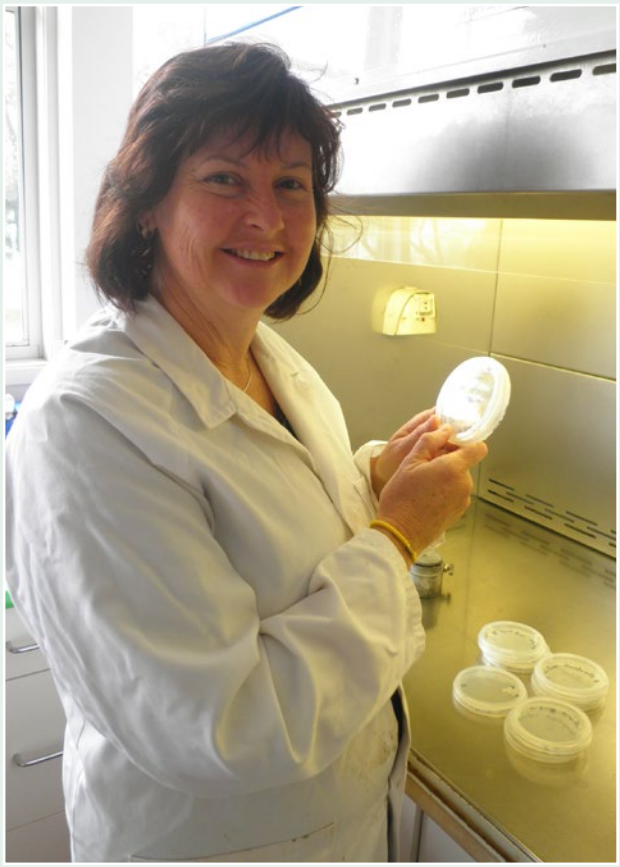


Figure 1. Effect of row spacing and genotype on (a) percent N derived from the atmosphere (%Ndfa) and (b) total amount of N fixed for mungbean grown at Redvale, near Kingaroy, Queensland.

Inoculation in dry conditions



Nitrogen-fixing *Rhizobium* bacteria do not survive well in dry soil conditions. For nodulation to be effective the plant root hairs must encounter and wrap around the live bacteria, which then 'infect' the plant root and form nodules where the bacteria live and reproduce.

Dr Seymour says that even if dry conditions cause high mortality rates in the bacteria applied at planting, some of the bacteria will survive. "Consequently, in dry conditions it may be worthwhile applying more inoculum per hectare," she says. "Care of the inoculum is required, both before and during planting, to ensure as many of the bacteria survive as possible."

Using the water injection method or granules may also help maximise survival rates. Dr Seymour is aware of the growing practice of mixing inoculum with liquid fertiliser to save time and with the view of delivering the inoculum into moist soil. "There are potential advantages in doing this but there are also important risks to consider," she says. "Rhizobia are sensitive to pH and to direct contact with heavy metals such as zinc and copper. The pH of some liquid fertiliser formulations is as high as 9.5, which is very toxic to rhizobia."

Dr Seymour and Mr Kerry McKenzie (Senior extension agronomist, DAFF Queensland) are undertaking studies into the compatibility of various liquid fertiliser formulations and rhizobia.

"Mixing directly with pesticides is definitely not recommended under any circumstances and for now, I would also advise against mixing with fertilisers," she says.

While peat slurry inoculation is still the most widely used method in the northern growing region, Dr Seymour says there is an increasing interest in the use of inoculant granules and the freeze-dried products now available.

"The granules are quite fine and do not always mix evenly with the seed in the seed box, which may result in uneven distribution in the paddock," she says. "Where possible we recommend applying the granules through a small seeds box on the planter."

The freeze-dried product has some advantages, such as not needing to be kept in the fridge, but must be applied with a buffer or protectant. Dr Seymour says she has heard favourable reports from growers and expects increased use of both the freeze-dried and granular products over time.

PHOTO: Erika Fish, QUT

Spotlight on tropical pulses

Chickpea and mungbean blue-sky research

Professor Sagadevan Mundree (left) and PhD researcher Michael Dodt (front, right) explain their drought-tolerant mungbean research to Australian Mungbean Association president, Rob Anderson (front, left) and other industry stakeholders, including Pulse Australia national development manager, Gordon Cumming.

by Cindy Benjamin

Research at Queensland University of Technology (QUT) focussed on improving competitive advantages for Queensland's mungbean and chickpea growers is gaining ground.

At an Australian Mungbean Association (AMA) meeting, industry stakeholders toured the QUT facility and AMA president Rob Anderson was impressed with the variety of work being undertaken.

Led by Professor Sagadevan Mundree at the Centre for Tropical Crops and Biocommodities and funded by a $4.8 million State Government research grant, the work is leading the way in genetic crop improvement (breeding, pre-breeding, biotechnology), improving drought and heat tolerance of tropical pulse varieties and enhancing disease resistance and farm management practices.

"Some of our research will have immediate impacts on the mungbean and chickpea industries in Queensland while the benefits of other projects will be realised in the short to mid-term," says Professor Mundree.

A promising project that may deliver immediate benefits to growers is a chemical pre-treatment of seeds that has proven successful in tissue culture and glasshouse trials. A field validation of the treatment of mungbean seeds was completed over the 2013–14 summer and a similar trial with chickpeas in 2014.

"Until all the data is analysed, we are being very cautious but the seed treatment does seem promising and, if validated in the field, could possibly be commercially available to industry quite soon," he says. "The aim of the seed treatment is to improve root growth and extend the root–soil interface so the plants can access more of the available moisture and nutrients.

"This technology has been used for many years to assist plant establishment in forestry and mine rehabilitation situations and has important implications for yield and reliability of pulse cropping in adverse seasons."

Professor Mundree says all the field data collected for mungbean and chickpea indicate that the seed treatment is very beneficial, producing very impressive root system development. As a final confirmation the project team is planting out field trials under rain-out shelters to remove the influence of rainfall during the trial period.

Other project work under the Tropical Pulses for Queensland project at QUT will enhance the plant breeding work of the National Mungbean Improvement Program (NMIP), a joint initiative of the Department of Agriculture, Fisheries and Forestry (DAFF) and GRDC. This collaboration will see new genomics and technology applied to mungbean to understand the diversity of recently imported germplasm and help identify traits that can be used in the breeding program for drought-tolerance, tolerance to heat at flowering and various diseases.

DAFF pulse plant breeder, Col Douglas, says that the future increases in mungbean yield over varieties such as Crystal$^{\phi}$ and Jade-AU$^{\phi}$ will come from combining new technologies with traditional plant breeding methods.

"Understanding the physiological processes inside the plant, or 'how mungbeans work' as well as access to new breeding technologies are critical for us to better the previous yield gains of Crystal$^{\phi}$ and Jade-AU$^{\phi}$," he says. "We are also looking at new ways to speed up the plant breeding process".

The project is also capitalising on the computer modelling that the sorghum breeders have used very successfully at DAFF's Plant Breeding Centre of Excellence at Hermitage Research Facility.

The Agricultural Production Systems Simulator (APSIM) assists researchers as they bring together plant breeding, plant physiology and crop agronomy to develop growing guides for farmers.

Professor Mundree hopes that new varieties will be developed that are suited to more soil and climatic conditions than the current varieties and new agronomy practices are likely to be required.

"The capability of APSIM and the information from the world-first Nested Association Mapping populations provides excellent genetic data to inform the plant breeding program," he says. "In addition to yield and adaptation traits we are also aiming to increase the nutritional value of these already protein-rich grains with increased iron content."

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Mungbean's bright future

In the last five years the volume of mungbean produced in Australia has increased three-fold and Rob Anderson, president of the Australian Mungbean Association (AMA), believes there is room for further expansion over the coming five years.

"We have set a goal to increase Australian production to average 170 thousand tonnes by 2019," he says. "The development of new varieties, dedicated industry development, accredited agronomists and some blue-sky research will support growers as they incorporate mungbeans into their crop rotations."

The National Mungbean Improvement Program (NMIP), a partnership between Department of Agriculture, Fisheries and Forestry (DAFF) plant breeders, the Grain Research and Development Corporation (GRDC) and the AMA, released three new varieties that have underpinned the expansion of the industry in recent years.

"Coupled with the industry development work of Pulse Australia and our dedication to the Certified Seed Program and Accredited Agronomist training, growers have had access to the best possible resources to confidently grow this very fast maturing crop," says Mr Anderson.

To date the NMIP has concentrated on traits such as higher yield, better disease resistance and improved harvestability in the new varieties, Crystal$^{\Phi}$, Satin III$^{\Phi}$ and Jade-AUI$^{\Phi}$.

The majority of the Australian crop is culinary grade and consumers in Asia view mungbeans more as a vegetable than a grain. The AMA has developed a 5-year strategic plan in consultation with over 150 stakeholders that will see the further development of existing markets and the securing of new markets elsewhere in Asia.

"Australian mungbeans are well-received in the marketplace because of the priority we place on our quality product, which is verified safe to eat and clean," says Mr Anderson.

"We can't let our guard down and as the industry expands it is essential that we maintain this reputation through product traceability on grower declarations regarding input use."

"The new high yielding varieties also require a renewed commitment to mungbean agronomy research," he says. "The AMA is encouraging research and extension projects that will further refine the best management practices for irrigation, crop nutrition and integrated pest and disease management in mungbeans."

The AMA heads into the next five years with well-founded optimism. There is room to expand production in the traditional summer growing areas of Queensland and northern NSW and the whole supply chain is ready to respond.

"We have put strategies in place to support the expansion of the mungbean industry and growers can be very confident to include mungbean in their rotation, taking less than 100 days to produce a high quality protein food," says Mr Anderson.

DAFF senior plant breeder, Dr Col Douglas, leads the National Mungbean Improvement Program (NMIP), generating high yielding varieties with better disease resistance and improved harvestability.

More money from narrow rows?

Substantial yield benefits may be possible in the North, even in dry years

Small plot trials at Dalby showed the benefits of narrow rows and higher plant density in chickpea productivity.

by Cindy Benjamin

A chickpea yield increase of just 10 per cent would be worth $20–25 per ha across the northern production area, earning an extra $2.5–3.0 million per year to the industry. Improvements like this would have the knock-on effect of encouraging more growers to include chickpea in their crop rotation and hopefully bring the sown area closer to the 15 per cent required to achieve sustainable grain production in the region.

Researchers Kerry McKenzie in Queensland and Dr Andrew Verrell in northern NSW are on a mission to see greater productivity from chickpea crops and their trial work is strongly suggesting that growers can achieve significant gains through relatively simple adjustments to row width and plant density.

"In Queensland the conventional row spacing is 75 cm to 100 cm to fit with wide-row summer crops such as cotton and sorghum," says Mr McKenzie. "Contrary to the conventional view, there is little to no yield loss from planting in narrow rows in drier years and in favourable years narrow rows (50 or 25 cm) can produce up to 25 per cent higher yield (in SQ) than conventional 1 m row spacing."

The highest yield achieved in a 2013 Dalby trial site was 4.7 t/ha with an advanced breeding line (CICA0912) at 25 and 50 cm row width. PBA HatTrick$^{\phi}$ and PBA Boundary$^{\phi}$ were not far off, yielding 4.5 and 4.4 t/ha respectively at 25 cm row width, a result that impressed trial cooperator, Glen Milne. In response to his observations of the effect in the trial on his farm Mr Milne used his 30 inch (75 cm) planter to double sow their 2014 chickpea crop in 15 inch (38 cm) rows. The yield achieved in his commercial crops at the narrower spacing was pleasing at up to 4.2 t/ha. In 2013 the chickpea yield on 100 cm rows was 3.1 t/ha.

"The nitrogen contribution through stubble was also up 30 per cent from narrower spacing due to the higher biomass production and a higher percentage of the nitrogen being derived from the atmosphere, compared to crops sown in 100 cm rows," Mr McKenzie says. "Harvest index increased from 0.43 to 0.48 across all varieties at the Dalby site."

Water use efficiency is a valuable measure of the potential suitability of a crop in a farming system. In this trial, very high water use efficiencies were achieved, approaching those generally accepted as satisfactory for cereal crops. Water use efficiency was over 17 kg/mm/ha at 0.25 cm spacing at Dalby and over 13 kg/mm/ha at Warra, compared to the usual expectation of 7–8 kg/mm/ha for pulses.

In northern NSW row spacing trials at Tamworth Agricultural Institute show the benefit of narrow row spacing (40 cm or less) in situations were there is high yield potential or when sowing very late.

Over four site years, narrow row (40 cm) PBA HatTrick$^{\phi}$ chickpea crops consistently out yielded crops sown in wide rows (80 cm). Within the optimal sowing window (early May to mid June), averaged across

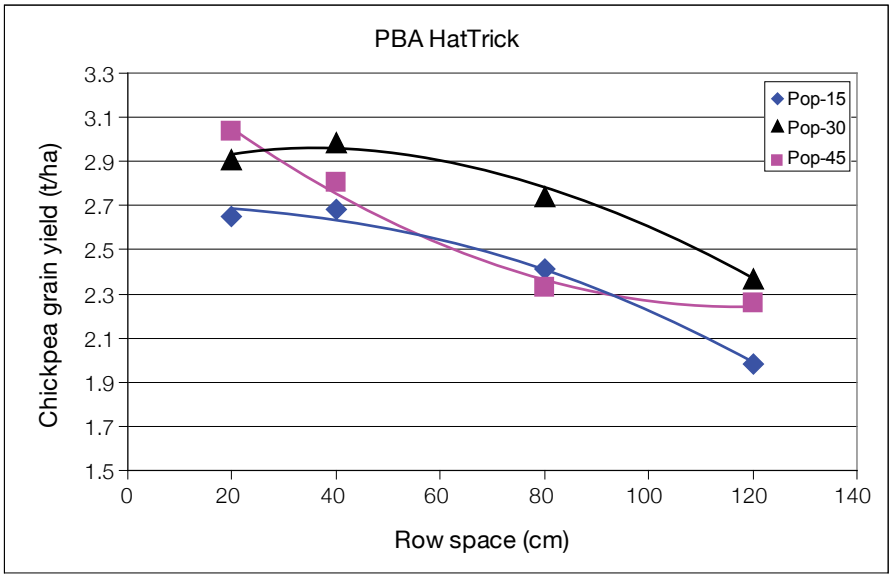

Figure 1. The effect of row space and plant density on grain yield of cultivar PBA HatTrick

varieties, wide rows have averaged 2.17 t/ha while the narrow row spacing averaged 2.53 t/ha, a respectable 16 per cent increase.

"When sowing within the optimal sowing window, these results suggest sowing on narrow rows—40 cm or less—is best if the yield potential is 2 t/ha or more," says Dr Verrell. "If the yield potential is below 2 t/ha then row spacing has less impact on yield."

"If sowing very late, then we recommend sowing on narrow rows at adequate plant density but if sowing early, wider rows will reduce early soil water extraction."

Trials assessing plant density showed significant yield loss across all row spaces at low plant density (15 plants/m^2). At 30 plants/m^2, yield was flat up to 40 cm but was significantly lower at 80 and 120 cm (see Figure 1).

Disease management x row width (chickpea)

A compromise may be necessary to balance improved yield with effective disease management. During the season the chickpea crop may be infected with fungal leaf diseases, such as ascochyta blight and botrytis grey mould. The extent of the infection of these diseases is thought to be affected by the amount of air flow through the canopy and prevention relies on the application of fungicides to lower leaves, particularly during podding, when all varieties are susceptible.

Narrow row width, less than 40 cm, could promote the spread of infection and make it more difficult to apply fungicide. Row spacing of say 50 cm will enable effective spray application while still providing a yield benefit over 80 cm or wider row spacing. To reduce the risk of fungal diseases taking away the potential yield advantage, be sure to avoid planting into paddocks sown to chickpea or any other host crop in the last three years, control volunteer chickpea plants between crops and apply protectant fungicides in front of the next rain event if the disease is identified in the crop.

On the other hand, aphids that carry plant viruses appear to be less attracted to dense, even chickpea crops. Sowing between rows of standing cereal stubble, sowing on time and targeting a plant population of at least 25 plants/m^2, and 30 or more plants/m^2 if the yield potential is above 1.5 t/ha, reduces the risk of aphids alighting in the crop and, in the process of feeding, spreading the virus.

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Breeding high yielding, virus resistant field peas for human consumption

The search for a northern region field pea

Steve Moore, University of Sydney plant breeder is optimistic about finding suitable breeding material from the 70 commercial and advanced field pea lines being evaluated for their adaptation for the northern region.

by Cindy Benjamin

The winter pulse crop options in the northern regions of NSW and through Queensland, including coastal zones, are heavily restricted by seasonal limitations, the disease spectrum and soil type.

Historically chickpea has been the best-fit pulse crop for the region with faba bean also attracting interest in recent years following the release of more suitable varieties for southern Queensland.

In trials conducted for the GRDC in 1995 however, field pea was identified as another crop well worth pursuing in a dedicated breeding program for the northern region.

Last year, University of Sydney plant breeder (now semi-retired), Steve Moore led a GRDC-funded project to evaluate 70 advanced and named field pea lines from the University of Sydney and Pulse Breeding Australia plant breeding programs.

"Evaluation trials were sown in Queensland (West Marr) and NSW (Narrabri, Gilgandra, Walgett, Spring Ridge and North Star)," says Mr Moore. "Our main interest is to identify lines that fit the narrow flowering window in the northern region—varieties that will produce a large number of flowers in the short window between the last major frost and the beginning of warm weather in spring. Once the temperature rises over 30°C field pea flowers don't set seed or they produce pods with only a few, small seeds."

"The varieties suited to southern Australia typically achieve high yields through an extended flowering window," he says. "In the north the flowering window can be as short as five or six weeks from late August through September, and the further north and east the narrower the window becomes."

The breeding program has concentrated on identifying lines that produce multiple flowers per node, say 2–3 flowers on each of the first six nodes. Mr Moore says that even in the other regions the bulk of the yield is derived from the first 4–6 flowering nodes.

The other limiting factor in the northern region is the different disease spectrum affecting field pea, particularly powdery mildew and luteoviruses. While existing varieties generally have good levels of resistance to seed-borne viruses, there is limited resistance to the aphid-transmitted luteoviruses. Breeding line 07129F2.49.1R1 is showing good resistance to Pea Seed-borne Mosaic Virus (PSbMV), Beet Western Yellow Virus (BWYV) and Bean Yellow Mosaic Virus (BYMV).

Having field pea varieties adapted to the northern region would significantly increase growers' options to respond to seasonal conditions with the most suitable pulse crop. "Chickpea is likely to always be the most profitable option on suitable soils," says Mr Moore. "Faba bean can be planted early in years when there is good soil moisture available. To break even with field pea we use the rule of thumb yield of 2.5 t/ha, but their advantages lie in their tolerance of a wider pH range (4.5 to 8.9) than chickpea, giving growers on difficult soils an option to build soil-N in their rotation."

There are also weed control advantages to a short season crop such as field pea, which already has a wide range of pre- and post-emergent herbicides registered for use in-crop compared to chickpea and faba bean. Mr Moore says it is possible to gain the upper hand with weeds by treating late germinations of grass and broadleaf weeds during the longer pre-sowing period and post-emergence. Field pea can be planted later than faba bean, from mid May to the end of June. This growing window may be well suited to cotton rotations in the north.

Trials to date have identified a number of promising lines bringing characteristics such as 60 days to flowering (up to 30 days less than commercial varieties), quick finish suited to the northern region, improved standability, yield (up to 20%) and suitable disease tolerances.

"Variety 03PP094-12M is a dun pea suited to the human consumption market in China which, if given the green light, is ready for immediate commercial release," says Mr Moore. "We have also developed a sound understanding of the agronomy package required for this variety."

The university's collaboration with Plant Research Ltd New Zealand has provided access to an international range of germplasm.

"Crossing and selection of the best offspring has been performed both in Australia and by partners Plant Research Ltd in NZ and the USA," says Mr Moore. "This partnership brings together the best breeding lines from around the world, plus unique mutant breeding lines developed in New Zealand."

"It also speeds up plant selection through shuttle breeding—a process where seasonal differences between hemispheres and variation in temperature allows breeding lines to be tested at least twice a year."

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A winter pulse for the coast

In some years it is difficult to successfully grow a summer legume crop in the Bundaberg area. Like many others in the district Tony and Katrina Chapman have experienced losses of up to 70 per cent of their usual income from summer grain legumes, such as soybeans, due to heavy rain or rain falling at the wrong time.

When looking for another break crop option for their sugarcane system Tony had three main criteria. The new crop needed to be a legume, to grow in winter and not be a weed in cane. He also hoped to find a crop that would provide an economic return.

His research led him to field pea, which are generally not considered well-suited to the coastal regions of Queensland, so in 2008 they planted about 2 ha just to see if they would grow.

The initial field trial was successful enough for the Chapmans to grow more the next year and they were able to harvest and sell the grain. After working with University of Sydney plant breeder Steve Moore and BGA Agri-services agronomist Simon Andreoli for a few seasons, Tony has developed a good understanding of the crop's requirements in the Bundaberg area. With increased crop management knowledge Tony is now confident that each crop he plants will yield a harvestable crop.

"We try to have something growing in all blocks, all year round," says Tony. "This is good for the soil biology and reduces the risk of erosion. The residue of a field pea crop is very soft and breaks down quickly, which is important given the small window between harvest and planting the next cane crop."

"Field pea are a low input, low return crop," he says. "They are worth growing just for their contribution to soil nitrogen, organic matter and surface protection. We sell the grain through Bean Growers Australia and also small quantities direct to local buyers."

Protecting pulse crops

Answering the challenges of 2014 season

Richard Lloyd and Kirsty Byers collecting helicoverpa larvae with a beatsheet to assess the level of NPV infection. Helicoverpa is a major pest in faba bean and in 2014 the pressure was on to refine the sampling techniques, control efficacy and economic thresholds in northern region crops.

by Cindy Benjamin

The 2014 winter pulse season threw up several challenges for pulse growers and researchers alike. Pulse Australia industry development managers actively supported the investigation and solving of pest and disease problems in a variety of cropping situations. Some, like charcoal rot in WA lupins, are unlikely to be ongoing problems, but managing helicoverpa in northern region faba bean crops and minimising the risk of aphids transmitting viruses in the southern region are bound to come up again in 2015.

CHARCOAL ROT AFFECTING STRESSED LUPINS

Extreme heat in August across the northern and eastern districts of Western Australia in 2014 gave charcoal rot a rare opportunity to infect lupin plants and affect yield. Charcoal rot is a widespread soil-borne fungus that rarely affects yield because pod set is complete and the crop approaching maturity before the impact of infection becomes evident.

Pulse Australia industry development manager (western), Alan Meldrum says there were patches in crops across several regions that dried off and died prematurely, showing signs of charcoal rot infection in 2014. "The patches that died were on very dry and shallow soils where the plants had very limited root systems and few deep roots. The high temperatures in August added to the drought stress in the plants."

Department of Agriculture and Food plant pathologist Geoff Thomas confirmed charcoal rot was the problem after observing the very distinctive stem symptoms of affected plants. "The stem and taproot near the soil surface become infected and when split open the distinctive ash-grey discolouration can be seen, partly caused by masses of tiny black microsclerotia embedded in the tissue," he says.

Macrophomina phaseolina, the fungus that causes charcoal rot is present in most areas and can infect a wide variety of plants. The disease can not be prevented but is only ever a problem in moisture-stressed crops when soil temperatures are warm.

The impact of charcoal rot is unlikely to regularly affect lupin and growers should take heart that this is probably a one-off event.

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Farm manager, Scott Treloar (left), with Jon Clements, DAFWA lupin plant breeder, investigating black lupins in September 2014, south of Arrino.

GRUBS CAUSING HEADACHES IN FABA BEANS

Faba bean crops on the Darling Downs came under pressure from helicoverpa larvae in 2014, potentially slashing returns if grain did not meet stringent quality standards.

Gordon Cumming, Pulse Australia national development manager, says controlling pests like helicoverpa is a priority if growers are aiming for the premium human consumption market for their faba beans. "The problem facing growers is that the economic threshold of 2 larvae/m^2, used to manage helicoverpa in southern Australia, does not seem to be sufficiently restricting grub damage in northern crops," he says.

The Department of Agriculture, Fisheries and Forestry (DAFF) entomology team, led by principal entomologist Dr Melina Miles, responded to the situation immediately with field sampling trials to determine more accurate economic thresholds.

"Helicoverpa larvae feeding on faba bean pods usually damage every grain, and these partially damaged grains go through into the sample," says Dr Miles. "As a result the yield may not be greatly affected but the whole crop might be downgraded. This means that the economic threshold for helicoverpa in faba beans is low."

The first step the entomologists took to unravel the problem was to determine whether the beatsheet sampling method was effectively sampling the larvae. The concern being that there may be more larvae in the crop that are not being dislodged with the beatsheet, therefore underestimating population size.

"We have completed one sampling trial comparing the efficacy of the beatsheet and sweep nets as sampling tools for helicoverpa in faba bean," says Dr Miles. "What we have found is that the beatsheet method collects about half of the larvae that are actually present on the sampled plants and the sweep net method collects only one-third of the total present. What is not effectively sampled with the beatsheet or sweep net are the small larvae in the buds, terminals and flowers."

The implication of this is that growers and agronomists need to conduct a visual inspection of flowers and growing tips in the sampled plants, as well as continuing to use the beatsheet. Dr Miles suggests that, until more scientific information is available, spraying decisions should still be based on the current economic threshold of 2 larvae per m^2, using both the beatsheet and visual inspection.

"By the 2015 season we will have a better idea of whether the economic threshold needs to be investigated, or if effective sampling is the main issue," she says.

The other concern that Dr Miles and her team are exploring is the efficacy of insecticides to control helicoverpa. *Helicoverpa armigera* is common in northern faba bean crops so synthetic pyrethroids are not recommended.

In field trials, under very cold temperatures in early July 2014, the DAFF entomology team evaluated the efficacy of a range of insecticides. Of particular interest was the efficacy of NPV (Vivus Max®). Whilst good levels of infection were achieved in the larvae, the extremely cool conditions meant that the larvae were not dying in the expected 10–14 days. This clearly demonstrated that NPV is best suited to application in faba bean in spring, rather than autumn–winter.

The other insecticides tested were ingestion-active, and the work on the distribution of larvae in the crop canopy has reinforced the importance of good coverage with these products.

"Being ingestion-active means that it is very important to get products like Steward® in very close proximity to where the target insects are feeding," says Dr Miles. "We got good control of small and large larvae in the trials, showing that with good coverage it is possible to control individuals in the growing tips and flowers."

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MONITOR AND CONTROL GREEN PEACH APHID

The early and unexpected influx of green peach aphids in 2014 caused severe damage to early sown canola crops in the southern region, with crops in South Australia being worst affected. Green peach aphid (GPA) is the primary vector of Beet Western Yellows Virus (BWYV) so the unseasonably high aphid numbers represented a risk of increased incidence of virus infection of broadleaf plants.

The Victorian Department of Environment and Primary Industries (DEPI) virology and pathology team at Horsham tested broadleaf plant samples from South Australia and Victoria for BWYV. The virus was detected in roughly 75 per cent of the 940 canola plant samples tested.

Southern region industry development manager Mary Raynes says chickpea, and possibly lentil, are the most susceptible of the pulses to BWYV.

"Chickpea crops growing adjacent to canola crops were at the greatest risk of infection," she says. "Although aphid activity ceased in response to the harsh frost in the third week of July, and no pulse crops tested positive for BWYV in 2014, the risk is very real and growers need to be vigilant with aphid monitoring and control."

Green peach aphids are very effective vectors of BWYV. After feeding on infected plants these aphids have a 97 per cent transmission rate, much higher than the disease transmission rates of other aphids.

Ms Raynes encourages growers across the southern region to monitor weekly for aphid activity and once temperatures start to reach 15–16°C, ramp up crop inspections to twice weekly with the intention to control without delay.

"Immediate control is highly recommended, keeping in mind that there is widespread resistance to carbamates and organophosphates in green peach aphid populations," she said. "No resistance to these active ingredients is reported in cowpea aphid or blue green aphid. Importantly, if resistant green peach aphids enter pulse crops there are no registered control options."

"Weeds such as marshmallow and wild radish growing near pulse crops can also host the aphid, so removing weeds on paddock boundaries is also important."

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To minimise aphid infestation and virus transmission, plant pulses between rows of standing stubble, avoid planting pulses and other broadleaf crops in adjacent paddocks and remove the 'green bridge' of volunteer crop plants and broadleaf weeds that host aphids.

Versatile pulses for weed control and soil fertility

Making the most of pulses in the rotation

by Cindy Benjamin

Aside from their cash crop value to a farm business, pulses also offer real agronomic benefits that support long-term sustainability of farming systems.

Often criticised in the past for being a haven for weeds, pulses can in fact become a strong link in southern and western cropping regimes—used strategically to control difficult weeds, reduce the soil weed seed bank and maximise nitrogen inputs.

Eric Armstrong, Pulse Research Agronomist at NSW DPI Wagga Wagga Agricultural Institute, believes pulse crops have been overlooked in recent years as many growers have chosen to primarily grow wheat and canola. "There are already signs of break-down in this system with a run-down of soil mineral nitrogen being evident and leading to increasing dependence on N fertiliser," he says. "Similarly weed pressure is building and the more frequent use of herbicides will eventually lead to herbicide resistance in weed populations."

Dr Armstrong recommends giving greater consideration to the value of pulse crops in the rotation to achieve agronomic stability. "The first step is to determine your priorities," he says. "If weeds are not a priority then a pulse crop should be included in the rotation for its ability to contribute to farm profits and soil fertility. If weeds are a priority then the decision should still be to include a pulse crop but with the intention of using croptopping to prevent weed seed set—accepting a yield penalty in return for bringing the weeds

	If weeds ARE NOT the priority	If weeds ARE the priority, particularly herbicide resistance
Maximise potential income	Grain harvest – maximise income, minimal effect on weeds, some return of fixed N to the soil. ▸ This is the most traditional and wide-spread practice for cultivating pulses in NSW and is based on well developed agronomy and crop management strategies from sowing through to harvest. ▸ This option assumes weeds are fully managed by conventional rotation and herbicides.	Croptopping – generate income (although there may be a reduction in yield), prevent weed seed set, some return of fixed N to the soil. ▸ This option is for 'mopping up' scattered weeds and preventing weed seed set in all weedy situations, including herbicide resistant weeds. ▸ Desiccation (croptopping) must occur at the critical growth stage of the weed. ▸ Effect on yield is largely linked to the physiological maturity of the pulse crop at the time of croptopping/desiccation. ▸ Most pulse varieties (e.g. chickpeas, lupins and Kaspa field peas) mature too late and so much of the potential grain yield is lost. These pulses are not recommended for desiccation. ▸ Newer varieties of peas are faster maturing and better suited to croptopping. Since peas are sown later than other pulse crops they extend the 'before-sowing' weed control window. ▸ Suitable early flowering and early maturing field pea varieties currently include PBA Pearl, SW Celine and PBA Oura.
No income, potential cost saving	Brown manuring – maximise soil N returns. ▸ The amount of N_2 fixed is linked closely to dry matter (DM) production of the legume (see Figure 1), therefore 'manure' the weed-free pulse crop close to its maximum DM. ▸ For a typical Morgan (long-season) field pea crop sown at Wagga in late May, this would mean desiccating around the end of October (see Figure 1).	Brown manuring – cost-effective way to control herbicide resistant weeds. ▸ In this situation, it is imperative to desiccate the crop at or before the milky dough stage of the targeted weed. ▸ This can coincide around the flat pod stage of the pulse and inevitably falls well short of the crop's peak DM. ▸ Since at this stage, the crop is growing at its maximum rate (around 80–100 kg DM/ha/day), the amount of N fixed will be proportionally reduced according to its growth stage at desiccation (see Figure 1). ▸ This is the necessary cost incurred to insure complete weed control.

under control. Brown manuring the pulse crop is the last option and would only be chosen in very high weed burden situations."

"When croptopping, timing is critical to prevent seed set of the target weeds," says Dr Armstrong. "The weed seeds must be in the milky dough stage for croptopping to be an effective weed control measure. Some of the earlier maturing varieties of field pea are better suited to this option than chickpea, lupin and Kaspa field pea, which generally mature after the target weeds have set seed, meaning these crops would essentially be brown manured as limited amounts of pulse seed would be set when the herbicide needs to be applied."

If brown manuring is necessary then plan to desiccate the crop at the peak of dry matter production, and when the weed seeds are in the milky dough stage, to maximise the soil health benefits of the pulse crop while having greatest impact on herbicide resistant weeds. "Brown manuring has a positive impact on the soil moisture and soil nitrogen available for the next wheat crop, although this is unlikely to cause a yield increase in the following wheat crop that will fully compensate for the income lost in the sacrificed pulse crop," says Dr Armstrong.

Some of the decisions surrounding the use of manuring and croptopping can occur during the growing season as seasonal conditions dictate. However Dr Armstrong recommends growers give careful consideration to the use of pulses when they are planning their crop sequence several years in advance—always including a pulse crop and periodically planning to grow a pulse most suited to croptopping as one option in an integrated weed control program. From an economics point of view it is important to calculate returns over the whole crop sequence rather than for each crop on its own as this will take into account any benefits or savings in soil moisture, soil nitrogen or pest and disease management.

"Growing a pulse crop with the intention of harvesting the grain relies on careful paddock selection to minimise disease risk and to match the crop to a suitable soil type," he says. "Good agronomic practice and a weed-free environment will generally reward the grower with the crop reaching its yield potential. In the process the soil is enriched and income flows into the business."

In contrast, green or brown manuring will have a negative effect on farm income in the first year. This option is only viable if it is likely to solve a costly problem in a way that can't be done using croptopping.

"Manuring is the best option for longer-seasoned forage types while earlier maturing grain types are more suited to croptopping," says Dr Armstrong. "Brown manuring is the safest strategy under heavy weed burdens and to control herbicide resistant weeds."

If the problem is a negative nitrogen budget then the loss of N in harvested grain must be considered and the crop must still receive good care to minimise the effect of disease, weeds, drought and sowing time on the potential N benefit. Good between-season summer weed control and the proper handling, mulching and breakdown of the pulse stubble over summer is essential to conserve both fixed N and soil moisture.

"Pulse grain varieties are getting better and better, with Pulse Breeding Australia being very active over the past 10 years breeding new lupin, field pea, chickpea, faba bean and lentil varieties," says Dr Armstrong. "These new varieties produce higher and more stable yields, have better disease resistance and are better adapted to southern and western systems than many of the older varieties."

This work is supported by the GRDC Pulse Agronomy Project *'Expanding the use of pulses in the southern region'* and by GRDC Pulse Breeding Australia (PBA) projects for breeding field pea, faba bean and lentil.

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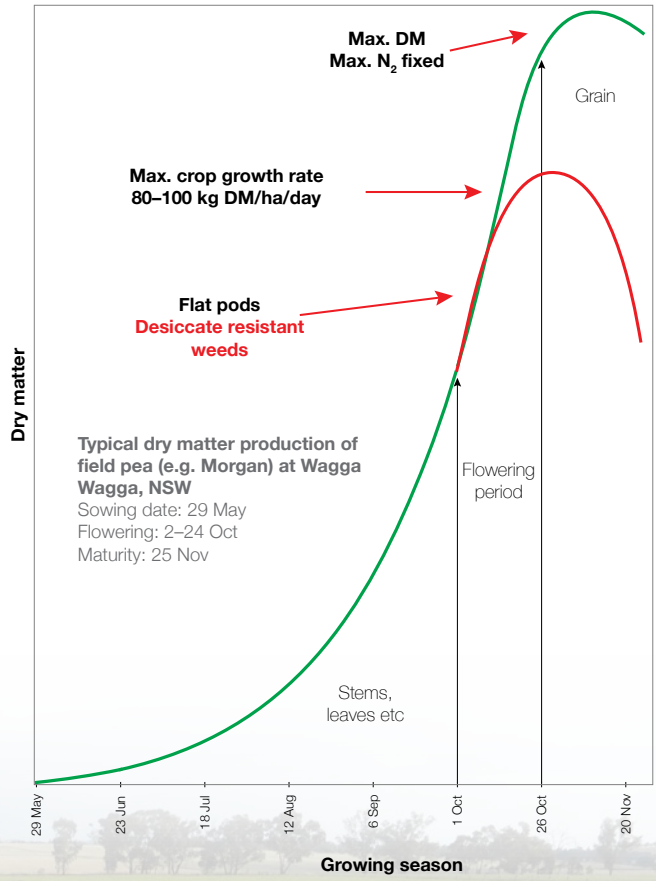

Figure 1. Dry matter production pattern of Morgan field pea over the growing season at Wagga Wagga in southern NSW under good growing conditions and free of disease and weeds. The amount of dry matter produced depends on the season and typically varies as much as 2–10 t/ha.

FTAs and Economic Partnerships good for pulse trade

The removal of tariffs through Free Trade Agreements is a positive step toward opening up new markets for pulses, but some other barriers may remain in place that effectively prevent trade.

by Cindy Benjamin

The last 12 months have seen some remarkable changes occurring in the international trade of agricultural produce, including pulses.

After many years of negotiations several free trade agreements (FTAs) and economic partnership agreements have come to fruition and others have taken meaningful steps forward. Pulses have been included in all three of the Free Trade Agreements (FTA) that Australia has signed this year.

Tony Russell is Executive Manager for Grains Industry Market Access Forum (GIMAF), which draws together peak industry bodies, including Pulse Australia, to work with the Australian government and its agencies to develop and implement international market access plans for the grains, fodder and seeds industries.

He says that while the reduction or removal of tariffs is significant it does not remove all barriers to trade. Nor does it mean that huge new markets will suddenly open up to demand Australian pulses.

"The Korea–Australia FTA includes the phasing out of quite large tariffs (27%) on chickpea, lentil and faba/broad bean over 5–10 years," he says. "Pulses do not feature strongly in Korean cuisine but they are certainly not an unfamiliar food. This FTA removes a significant trade barrier and gives Australian exporters an opportunity to do business and grow the market for pulses in Korea."

The United States of America has enjoyed tariff-free trade with Korea since 2012 and Canada has also recently signed a free trade agreement with Korea that will phase out the tariff on pulses.

The Japan–Australia FTA negotiations concluded in April 2014 after seven years of talks. The agreement (known as Japan–Australia Economic Partnership Agreement) includes the abolition of 8.5% tariffs on chickpea and lentil imports, to take effect immediately the agreement comes into force. As with Korea, this FTA will open doors of opportunity but is unlikely to have an immediate impact on pulse markets in Australia.

The China–Australia FTA includes the phasing out of tariffs of up to 7.5% on various pulse commodities over the four years following the FTA coming into force. Unfortunately there are no phytosanitary protocols in place for pulses from Australia into China. "This means that although the tariffs will soon be removed it will not be automatically possible for Australia to supply pulse products to China," says Mr Russell. "Buyers in China are interested in Australian pulses, particularly faba bean, and this interest will assist in the negotiations required to encourage officials in China to undertake the necessary risk assessment so trade can commence. GIMAF continues to push for progress on phytosanitary protocols for pulses."

Opportunities may also exist in China for lupin as stockfeed, especially for their burgeoning dairy industry, however Australian lupin processors and growers are keen to develop the higher value lupin for human consumption market in China.

GIMAF will continue building relationships and trust with authorities in China with the view to gain trade access for both lupin and faba bean.

In March 2014, after years of lobbying efforts by Pulse Australia and CBH, along with technical negotiations by Department of Agriculture officials, processed lupin

for human consumption (split or ground) was granted market access to India. Lupin production in Australia has declined over the last decade due to a lack of markets prepared to value the commodity at a level that provides a competitive return to growers.

Mr Russell says recent publicity around the unique nutritional benefits of lupin in a human diet may have encouraged Indian authorities to consider the inclusion of lupin in the mix of pulses marketed and consumed in India. This announcement of the acceptance of lupin for human consumption in India may kindle a renewed interest in the production of lupin as an important broadacre rotational crop.

"Mandatory methyl bromide fumigation, demanded by Indian authorities for a range of pulses, including lupin, remains an unresolved issue," says Mr Russell. "GIMAF is developing a strategic plan for India to focus on market access problems is a priority for 2014–15."

Most recently Australian Prime Minister Tony Abbott announced plans to progress with the India–Australia FTA. Other trade barriers also exist for pulses into India however having an FTA in place is likely to assist with the negotiations surrounding the other barriers.

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Trade negotiations take time

Australia has the following FTAs in place:

- New Zealand (ANZCERTA – effective 1 January 1983)
- Singapore (SAFTA – effective 28 July 2003)
- United States (AUSFTA – effective 1 January 2005)
- Thailand (TAFTA – effective 1 January 2005)
- Chile (Australia–Chile FTA – effective 6 March 2009)
- ASEAN–Australia–New Zealand Free Trade Area (AANZFTA – effective 1 January 2010)
- Malaysia (MAFTA – effective 1 January 2013)
- The Republic of Korea (KAFTA – effective 12 December 2014).

FTAs completed but not yet in force:

- China–Australia FTA—negotiations concluded on 17 November 2014.
- Japan–Australia FTA— negotiations concluded on 7 April 2014, and will enter into force on 15 January 2015.

FTAs under negotiation:

- India–Australia FTA to be fast-tracked.
- Indonesia-Australia Comprehensive Economic Partnership Agreement (IA-CEPA)—negotiations commenced on 26 September 2012 and continued in 2013.
- Australia-India Comprehensive Economic Cooperation Agreement (CECA)—negotiations commenced on 12 May 2011. The fifth round of CECA negotiations was held in Canberra in May 2013. Agriculture related issues are still to be discussed in detail.
- Trans–Pacific Partnership Agreement—Australia joined negotiations in November 2008. The TPP will build on the current Trans–Pacific Strategic Economic Partnership Agreement between Brunei Darussalam, Chile, New Zealand and Singapore (which entered into force in 2006) to also include the United States of America, Peru, Vietnam, Malaysia, Mexico, Canada, Japan and Australia. TPP parties intend to develop a high quality comprehensive 21st century free trade agreement that increases economic integration in the Asia Pacific region.
- PACER Plus—beginning on 18 August 2009, Australia commence negotiations on a new regional trade and economic integration agreement with the Pacific Forum, involving Australia, the Cook Islands, the Federated States of Micronesia, Kiribati, Nauru, New Zealand, Niue, Palau, Papua New Guinea, the Republic of the Marshall Islands, Samoa, the Solomon Islands, Tonga, Tuvalu and Vanuatu.
- Regional Comprehensive Economic Partnership (RCEP)—negotiations were launched on 20 November 2012. RCEP is an ASEAN centred agreement which will initially include the ten ASEAN countries and the six countries with which ASEAN has separate free trade agreements (FTAs): Australia-New Zealand, India, Japan, China and Korea. RCEP will support improved Australian trade with a group of countries that accounts for almost half the world's population and 60 per cent of Australian exports of agricultural, fisheries and forestry products.
- Gulf Cooperation Council—negotiations on an FTA with the Gulf Cooperation Council (GCC) remain on hold while the GCC reviews its trade agreement policies.

Source: Department of Agriculture www.agriculture.gov.au/market-access-trade/fta

Bulk shipments one year, containers the next

MV Sainty Vitality docked at Portland, Victoria. Photo: J Sawa

by Cindy Benjamin

After an exceptional season in 2013, there is no question that the faba bean crop in southern Australia endured a difficult season in 2014. Early estimations suggested that the average yield across the growing regions would be down 50 per cent.

After last season's success the sown area increased 15–20 per cent in 2014 but a combination of hard frosts and a hot dry finish affected crops across the region.

According to Nick Poutney, GrainCorp's head trader for pulses, the smaller crop in Australia was supportive of local values because the main importer, Egypt, had already sourced a significant proportion of their requirements for the year from the UK and France, which both had more product than usual to export.

"If Australia also had a large crop we may have suffered a price slump due to an over-supply of the market," he says. "As it was the high prices $430 plus per tonne stayed firm as the harvest came to a close."

Egypt imports about half a million tonnes of human consumption grade faba beans each year, roughly one-third of which is sourced from Australia. The level of demand is very consistent from year to year so the major influences on prices are supply-driven factors.

Mr Poutney believes there is growth potential for faba beans outside the Egyptian market, particularly in Saudi Arabia and Indonesia. "Faba bean flour adds significant nutritional benefits to many baked foods and I expect the market to grow as the benefits are promoted in the lead-up to the International Year of Pulses in 2016."

"Unlike cereals, pulse markets are often aligned to a single importer, such as faba bean to Egypt and chickpea to India," he says. "In faba bean we see Egypt dominating global trade, buying over half of the faba bean traded internationally. This type of market dominance is quite common in pulses but very rare in cereals."

The vast majority of Australian faba bean are delivered direct to packers rather than to the bulk handling facilities.

"Of the 300 000 tonnes exported from Australia in 2014, only about 50 000 tonnes was exported in bulk while the containerised trade accounted for around 250 000 tonnes," he says. "Faba bean colour and size are the most important traits when it comes to marketing the grain into the human consumption market."

The faba bean harvest in France in September was followed by the United Kingdom in October and finally the Australian crop in November. Egypt consistently purchases around a third of their requirement from Australia due to the preferred colour and size of Australian faba beans, which command a premium. This demand will be slightly more or slightly less depending on the supply and quality Egyptian buyers can achieve from Europe.

"For the 2014 season, with ample European supply, we anticipate the Egyptian requirement from Australia will be slightly less than a third, which will complement our smaller harvest this season," says Mr Poutney.

Following the severe conditions this season and the long-term outlook indicating another dry season ahead Mr Poutney is encouraging growers to stay with faba bean, which he believes will remain a profitable option for growers. "Faba bean are also good for the soil and are the best-fit pulse for the irrigation areas in southern Australia," he says.

The Fiesta-type faba beans—Farah, Fiesta, Nura and PBA Rana$^{\Phi}$—are the most commonly grown across southern Australia. PBA Samira$^{\Phi}$, released in spring 2014 for the high rainfall regions, is also suitable for markets like Egypt that favour the Fiesta-type faba beans.

Pulse Australia helped develop the market in Egypt through the negotiation of product specifications with the Egyptian Government over a decade ago. Production estimates for faba bean show a 5-year average planting area of over 160 000 ha and an average yield of 1.7 t/ha, and up to 3.0 t/ha in more favourable areas and under irrigation.

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Lupin market rallies

by Cindy Benjamin

It has been quite a while since lupins were in favour but 2014 could be the year that marks a significant turn in the prospects for this crop that has much to offer in West Australian cropping systems.

CBH Group Business Relationships Manager at Geraldton, Claire Sullivan believes that the improved global price for lupin is a reflection of the current tight supply of soybean for stockfeed in North and South America.

Lupin prices are also up compared to wheat prices due to a tapering off of demand for wheat following strong production in the Northern Hemisphere.

Ms Sullivan says most growers stayed with their crop rotations, however the forward price contracts are around $300 per tonne in 2014 were supportive of sowing lupins.

"Many growers took up some small forward contracts for a portion of their expected crop and most were cautious about their yield estimates," she said. "It is not wise to over-commit early in the season, but locking in a portion of the crop early certainly reduces the overall price risk for the season."

Ms Sullivan says that the commitment to deliver a certain tonnage needs to be realistic and take into account the risks associated with variability in conditions throughout the season.

"Growers in the more reliable rainfall areas might be comfortable with locking in up to 50 per cent of their expected yield while in lower rainfall zones growers are likely to be more cautious with their yield predictions and may commit less of the crop to a forward contract," she says.

By September growers have strong market indicators for the likely price at harvest, once the American soybean harvest is complete.

"Growers should expect some price volatility in the lead-up to September each year as the market speculates on the soybean harvest results," she says.

The main bulk export market for lupin is Korea, a market that has had consistent demand for Australian lupin for feed rations. "There are other markets in Europe that we supply in containerised shipments," says Ms Sullivan. "Like all markets, buyers value reliable suppliers and will look elsewhere if an exporter is erratic in their ability to supply."

West Australian lupin production peaked in the 1999–2000 season at an estimated 1.4 million tonnes, approximately 1 million tonnes of which was exported. Droughts affecting the main cropping area around Geraldton in the mid to late 2000s saw WA exports drop below 150 thousand tonnes. This coincided with a global price slump due to bumper soybean crops in the Americas. In 2013 and 2014 the trend began to reverse with increased production and exports regaining some of the lost ground.

There is also a solid domestic trade between lupin growers and livestock producers in Western Australia.

While competing with soybean for market access, lupin also competes with canola for planting area. Canola has provided many growers with alternative weed control options but there is no flow-on soil nitrogen benefit for following wheat crops.

Pulse Australia Industry development manager, Alan Meldrum says that the value of additional nitrogen for the following wheat crop needs to be factored in to any economic comparisons. "The added nitrogen will help replenish soil nitrogen, particularly after a bumper wheat crop like in 2013 and will also contribute to higher yields in following wheat crops," he says.

"An extra 30 thousand hectares of lupin was sown in 2014 compared to 2013," Mr Meldrum says, "bringing the total area sown to about 290 thousand hectares. While average yields were down by about 10 per cent lupins performed as well as other crops in a difficult season."

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Helping Aussies eat more pulses

Can chickpeas do for pulses what quinoa has done for cereals?

by Cindy Benjamin

Vegetarian cultures around the world have intuitively made the connection between cereals and legumes in the diet—marrying together dhal and rice in India, beans and corn tortillas in Mexico, tofu and rice in Asia and peanut butter and bread in the US and Australia.

Nutritional science tells us that these combinations work because together cereals and legumes complement each other and provide a balanced intake of amino acids.

In the Australian diet however there is an overwhelming tendency toward the intake of highly processed cereal foods and legumes are largely neglected altogether. Reviewing and investing in nutritional science, advocating the value of whole and high fibre grains and legumes and educating consumers and health care professionals about using these foods to improve their health and wellbeing are the major motivational forces behind the Grains & Legumes Nutrition Council (GLNC) and its managing director, Georgie Aley.

Speaking specifically about pulses Ms Aley says that even a small increase in daily consumption would improve health outcomes for Australians, particularly those with lifestyle-related conditions such as cardiovascular disease, type-2 diabetes, weight management and cancer.

"Nutritional studies of the benefits of consuming pulses are few in number in Australia but there are some very significant studies that clearly indicate the value of increased legume consumption," she says. "For example, a seven year longitudinal study of older people from different dietary cultures (including Japan, Sweden, Greece and Australia) found higher legume intake was the best dietary predictor of longevity, regardless of ethnicity. This study suggested that for every 20 g increase in daily legume intake the risk of death fell by 7–8 per cent."

In November 2014, the results of a GLNC-commissioned study by researchers Professor Vicki Flood at the Faculty of Health Sciences, University of Sydney and Dr Joanna Russell at the School of Health and Society, University of Wollongong were revealed at the 2014 Nutrition Society of Australia Conference in Hobart. Professor Flood and Dr Russell reviewed data from the Melbourne Collaborative Cohort Study, also known as Health 2020, which was set up in 1990 to investigate the roles of diet and lifestyle of more than 41,000 Melbourne residents in causing cancer and other diseases.

Their review considered the role legumes played in protecting the study participants from disease and found that middle-aged people who ate legumes at least two times a week were 20 per cent less likely to die from cardiovascular disease, including stroke or heart attack.

With evidence such as this available, Ms Aley is keen to see the pulse industry embrace the opportunity to grow the domestic market for pulses in ways that directly meet the current drivers of food consumption in Australia.

"Pulse foods can directly answer to four of the 10 key trends in food, nutrition and health in 2015, including two of the top four—'Naturally functional' and 'Protein powered by naturally functional," she says. "This is an opportunity that I hope the Australian industry will embrace because consumers are ready to increase their intake of pulses like never before."

Ms Aley cites the increased value of many foods when quinoa or chia grain is added to the product. She says together, these grains have added $19 million to grocery items, almost half the total value-add of $40 million in Australia, according to Retail World.

Positioning of pulse foods to take advantage of consumer interest is key to successful product launches and longevity in the market and, in the case of pulses, can be done with the confidence that the product is beneficial in the diet, yielding long-term economic savings in health care. A 20 per cent reduction in the incidence of cardiovascular disease, type-2 diabetes and cancer is conservatively estimated to be worth a $1.2 billion saving in health care costs in Australia.

While new pulse products will be welcome on grocery shelves Ms Aley is keen to see a repositioning of existing whole pulse foods and a dedicated effort to educate consumers on ways to incorporate these products in their everyday meals.

Every two years GLNC conducts a 'consumption and attitudinal study', asking consumers why they do or don't incorporate legumes in their diet. Feedback indicates that people are unsure how to prepare pulses and how to include them in their diet. In response to this GLNC provides health care professionals, including GPs, practice nurses and dietitians, as well as consumers with recipes and fact sheets on pulses. They also reach out to an online consumer audience of 40 thousand on Facebook with the latest recipes and nutritional information.

"For right or for wrong many consumers are avoiding gluten and other potential allergens," she says. "World-wide almost 13 per cent of new products launched in 2013 were labelled as 'free-from' something. Consumers are looking for and buying products based on their claims to be 'gluten-free', 'dairy-free', 'preservative-free' and so on. Pulses can help reposition many well-accepted product lines, particularly baked goods, because gluten-free is now established as a long-term trend, not a fad."

Ms Aley says consumer interest in the protein content of their foods has changed dramatically over the last decade from the domain of body builders and into the minds of health-conscious consumers. "People are looking at the protein content of all packaged foods and choosing products that offer more protein," she says. "Again, pulses can be relatively easily included in many products to increase the protein content while maintaining taste and texture."

The number 1 key consumer trend is for 'naturally functional' foods. Pulses fit this trend 100 per cent, ticking boxes such as high protein, slow release carbohydrate, whole food nutrition, dietary fibre and low in salt and sugar.

"Wet seed beans, including chickpea, are the only canned vegetable in growth, up 3 per cent in 2013 and another 4.4 per cent in 2014," says Ms Aley. "In the US, hommus has experienced enormous growth from a $5 million market in 1995 to one worth $325 million in 2010. This is a very promising trend for chickpea producers in Australia."

Ms Aley sees many opportunities for innovative foods using pulses and cereals to capture the nutritional benefits and actively market pulses to Australian consumers, particularly in the lead-up to and during the International Year of Pulses in 2016 when the industry will be the focus of world-wide interest.

Source: New Nutrition Business (www.new-nutrition.com)

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Russell J & Flood V. *Regular Consumption of Legumes Reduces the Risk of Cardiovascular Mortality*. In: Proceedings of Nutritional Society of Australia Vol 38. 2014 Nov, Hobart, Australia

Value-adding chickpea

In just three years the Woods Group family business has launched a new foods division and brought a range of new value-added pulse products to market.

Angus Woods, manager of Woods Foods says the path from concept to product launch has involved more than he first anticipated but he is immensely pleased with the UltraPulse range of value-added chickpea and faba bean products the company has developed.

"We were convinced that consumers and food manufacturers would use more pulses if they had access to products that were easy to incorporate in a variety of foods," he says. "Developing products that tick all the boxes for human nutrition and food safety, and fit within the parameters of food manufacturing equipment and production systems has been a challenge."

Knowing that split chickpea from Australia was being made into flour overseas and sold into both traditional markets in India and Pakistan, and also into the gluten-free market in the UK, US and Canada, Woods Foods believed there was an opportunity and sufficient growth potential to justify a significant investment in research and development, marketing, infrastructure, plant and equipment.

"The flour market was the easiest way to test the water but was never going to be the main-stay of our food business," says Mr Woods. "Health-conscious Westerners are unlikely to take up eating pulses in the traditional ways of other cultures. We wanted to develop nutritious pulse products that would add functionality to manufactured goods such as biscuits, chips, breakfast bars and cereals, snacks and breads."

Mr Woods has found innovative companies in Australia and overseas are seeing the demand for higher protein and dietary fibre content in manufactured foods but it is still difficult to get all divisions of a large company to respond to a new concept such as incorporating pulses in their products or substituting other ingredients for pulses.

"These companies want to protect their brand and are very conscious of quality assurance," he says. "Australia's reputation for clean and safe produce has assisted us in our marketing. We have a no-compromise policy when it comes to food safety and the breadth of our company's interests in growing, marketing, logistics and now value-adding is a great advantage."

"We had to take significant risks to produce product samples that we could show manufacturers and demonstrate the ways our products could add value and a point of difference to their product range," says Mr Woods. "Having the backing of the Woods Group of companies certainly helped and was crucial to being able to respond quickly with the required volume once our products were accepted in the marketplace."

Several large food manufacturing companies are already using UltraPulse bulk products in a range of goods and, as predicted, the demand is steadily growing. By May 2015, Woods Foods' new value-added products will feature on supermarket shelves as new product lines for a multi-national brand, ready for Australian consumers to enjoy.

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BOARD OF DIRECTORS

Appointed 2011

PETER WILSON GDip Agribus

CHAIRMAN

Peter is the Director Northern States for Australia Milling Group, part of Alliance Grain Trading, based in Regina, Saskatchewan and listed on the Toronto Stock Exchange. Prior to joining Australia Milling Group, Peter held a range of senior management and trading positions with JK International Pty Ltd in Canada and Australia and AWB Ltd (formally the Australian Wheat Board).

Peter maintains a keen interest in production economics via a family farming and contracting business on the Darling Downs in southern Queensland. He is also a lecturer at the University of Queensland for the Commodities and Risk Management Unit.

Appointed 2005

DAVID MATTHEWS Dip BIT, GAICD

DEPUTY CHAIRMAN

David is a past president of Pulse Victoria and a long term member of the Australian pulse industry quality standards committee.

A pulse grower in the Wimmera area of Victoria, David is owner and managing director of Wimmera Grain, involved in accumulation, processing and marketing of pulses both domestically and internationally.

David is a leader in the broader Victorian grains industry, fostering on-going grower training, on-farm quality assurance and improved freight services.

David is heavily involved in new seed development for specialty pulses and in the commercialisation of new main stream pulse varieties.

He also serves on the Bendigo Bank Strategic Advisory Board.

Appointed 1998
Special Qualifications

RONALD STOREY BEcon

NON-EXECUTIVE DIRECTOR

Ron has over 30 years involvement in the Australian grains and agribusiness sector and was a senior executive with AWB Limited for almost 20 years, dealing with local and overseas grain marketing, risk management and logistics.

Since 2000, Ron has run an agribusiness consultancy (Storey Marketing Services) and in 2005 acquired Australian Crop Forecasters P/L (ACF), Australia's best known private and independent broad acre forecasting service.

Ron is also Chairman of Australian Grain Technologies P/L, (AGT) one of Australia's leading plant breeding companies.

Appointed 2011

SANJIV DUBEY MEcon, MBA

NON-EXECUTIVE DIRECTOR

Sanjiv is a director of GrainTrend Pty Ltd, Australia, an agribusiness export trading house based in Sydney.

Sanjiv is an experienced international trader having traded in India and Malaysia. He handles trade in both bulk and containerised cargoes.

Sanjiv has a sound understanding of the pulse industry in Australia and overseas, having dealt with both Australian growers and trade participants across the globe.

Sanjiv sits on the Executive Committee of the international pulses body CICILS-IPTIC and is on the panel of approved arbitrators of Grain Trade Australia (GTA).

Appointed 2008

FRANCOIS DARCAS BAgSc/Ec, MBA

NON-EXECUTIVE DIRECTOR

Francois commenced his career in the global grains industry with Louis Dreyfus in Chicago in 1989 and since held various positions with international grain and pulse trading companies in New York, Hong Kong, Paris, Switzerland and Melbourne.

He now operates his own pulse trading buisness, Agri-Oz Exports Pty Ltd.

Francois' International trade experience and network of contacts is an invaluable asset to the Pulse Australia Board in both developing overall policy and in responding to issues in international trade contracts, importing government inconsistency and so on, that may arise from time to time.

Appointed 2013

RODNEY BIRCH

NON-EXECUTIVE DIRECTOR

Rod owns and operates a large scale grain growing property near Coorow, WA.

Rod has considerable experience with multiplication and bulk up of new crop seed varieties with various breeding programs and has implemented an industry accredited quality assurance program across all production processes on the farm.

Rod has held a number of positions in the agricultural industry throughout his career and is currently a director of Australian Grain Technologies (Australia's largest, and market leading, wheat breeding company), a director of the Institute of Agriculture (University of Western Australia) and is the Chair of the Pulse Council of Grains Industry Association Western Australia (GIWA).

Appointed 2013

GEORGIE ALEY BEqBusMan, MBA

NON-EXECUTIVE DIRECTOR

Georgie is managing director of the Grains & Legumes Nutrition Council (GLNC) and chair of the Future Farmers Network.

GLNC is the independent authority on the nutrition and health benefits of grains and legumes across Australia and New Zealand, representing the whole value chain from growers to food manufacturers.

She is a Member of the Australian Institute of Company Directors and the Australian Institute of Food Science & Technology. Georgie was the inaugural recipient of the Rabobank Emerging Agribusiness Leader Award in 2013.

Appointed 2014

NICK POUTNEY BBus, BA

NON-EXECUTIVE DIRECTOR

Nick is a Senior Trader with GrainCorp, responsible for managing trade to the Middle East, Africa and Japan. Nick is also the Head trader for the GrainCorp Pulse business (specialising in peas, beans and lentils).

Based in Sydney, Nick has 15 years of international grain trade experience with Australian Wheat Board, Viterra and GrainCorp, including 8 years positioned in Geneva.

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Pulse research projects 2013–14

The GRDC aims to fund projects that address issues and priorities in the grains industry as identified through engagement with stakeholders. Projects are groups under the GRDC's six theme areas for investment. The tables below provide the project number and name of current projects with a strong pulse industry focus or component. Project summaries for all current projects (2013–14) can be found at: www.grdc.com.au/Research-and-Development/Project-Summaries

Theme 1—Meeting market requirements

DAN00139	Improving food quality and end use market acceptance of Australian pulses—cooking and sensory
DAN00196	Eliminating grain defects in chickpeas
DAV00132	Objective high-throughput technologies for the pulse industry

Theme 2—Improving crop yields

CSA00027	Adding value to GRDC's National Variety Trial network
CSP00185	Collection, phenotyping and exploitation of wild cicer genetic resources for chickpea improvement
CUR00021	An international collaborative effort to sequence the genome of field pea (*Pisum sativum*), a key tool for future breeding
DAN00151	PBA Chickpea—National Breeding Program
DAN00157	Evaluating remaining albus lupin breeding material at Wagga
DAN00190	Quarantine of cereals and pulses
DAQ00172	National Mungbean Improvement Program
DAS00112	Lupin evaluation for eastern Australia
DAS00117	New common and woolly pod vetch varieties for grain and hay/silage production for Australian farmers
DAS00120	Pulse germplasm enhancement—National coordination
DAS00121	Pulse germplasm enhancement—Abiotic stresses
DAS00140	Improving yield and reliability of field peas and chickpeas under water deficit
DAV00118	Pulse Breeding Australia—Field pea Breeding Program
DAV00119	PBA Lentil Breeding—expansion project
DAV00126	Molecular markers for pulse breeding programs
DAV00131	Australian Grains Genebank—Phase 2: 2013 - 2017
DAV00134	Diagnostic services for pulse germplasm enhancement and breeding programs
DAV00135	Genome sequencing of lentil—a collaborative approach with international partners
DAW00181	National Lupin Breeding for southern Australia
DAW00237	Lupin breeding for Australia
DAW00238	Development of lupin molecular markers tagging yield QTL genes and yield-related phenology traits
DEP00001	Australian Grains Genebank
ICA00011	Pre-emptive chickpea pre-breeding for biotic stresses and germplasm enhancement for abiotic stresses
UA00127	PBA Australian faba bean breeding program
UWA00147	Genome sequencing in narrow-leafed lupins
UWA00151	Unleashing the power of genomics for lupin marker development and crop improvement
UWA00159	In vitro tools for accelerated breeding and screening for abiotic stress in grain legumes

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Theme 3—Protecting your crop

AKC00004	Registration for minor use chemicals for the grains industry
AKC00005	Pathways to registration—Tactical pesticide registration program
AKC00006	Registration of minor use chemicals for the grain industry
CUR00012	Australian Centre of Necrotrophic Fungal Pathogens: Phase 3 Pleosporales Functional Genomics
CUR00014	New technologies and biological concepts for pre-breeding resistance to the Ascochyta blight diseases of pea, chickpea, lentil and faba bean
CUR00016	ACNFP-Fungicide benchmarks: Project Phase 2
CUR00018	Australian Centre for Necrotrophic Fungal Pathogens: Phase 3 - Pleosporales Effector Delivery
CUR00019	Fungicide evaluation of new generation actives in cereals and pulse crops
CUR00020	Managing on-farm biosecurity risk through pre-emptive breeding: the case of rust in field pea and lentil
CUR00022	Fungicide resistance management strategy and communications
DAN00140	New tools and germplasm for Australian pulse breeding programs to respond to changing virus threats
DAN00142	Differential herbicide tolerance of winter crops in S.E. Australia—extension
DAN00172	Managing crop disease—Improving chickpea pathogen resistance (PRR)
DAN00176	Northern NSW Integrated Disease Management
DAQ00153	Northern pulse and grains IPM
DAQ00164	Biological suppression of Root-lesion nematodes in grain-growing soils
DAS00131	Improving weed management in pulse crops through herbicide tolerance—Part B
DAS00132	Improving weed management in pulse crops through herbicide tolerance—Part A
DAV00117	Pulse Germplasm Enhancement Program—Resistance to biotic stresses
UM00039	Understanding pathogenicity risk within the current *Asochyta rabiei* fungal population and development of a revised disease management plan
UM00052	Improving grower surveillance, management, epidemiology knowledge and tools to manage crop disease—National Chickpea Pathology Program
UQ00059-DAQ	Herbicide tolerance screening of winter crops in NR (phase IV) (was DAQ00152)
UWA00129	Generation of genetically-modified herbicide tolerant narrow-leaf lupin
UWA00145	Innovative approaches to resistance to necrotrophic pathogens and sap-sucking insect pests.
UWA00152	Managing soil-borne diseases with a focus on Rhizoctonia (Part A UWA)
UWA00154	Strategies to provide resistance to the economically important fungal pathogen, *Rhizoctonia solani*

Theme 4—Advancing profitable farming systems

CSA00029	National integration of crop sequence strategies and tactics
CSA00037	Reassessing the value and use of fixed nitrogen
CSE00055	Crop sequences to manage soil pathogens and reduce the yield gap of northern grain production
CSP00146	Facilitating increased on-farm adoption of broadleaf species in crop sequences to improve grain production and profitability
CSP00160	Refining variety and management recommendations to improve productivity and resource use efficiency of dual-purpose crops in Australia
DAN00167	Variety Specific Agronomy Packages for southern, central and northern NSW
DAN00171	Northern Pulse Agronomy Initiative—NSW
DAN00191	Nitrogen fixing break crops and pastures for HRZ acid soils
DAQ00170	GRDC Grower Solutions for Central Queensland
DAQ00174	Cropping solutions for the sugarcane farming systems of the Burdekin
DAQ00180	Extension of Nitrogen Fixation Program outputs to end users—northern region
DAQ00181	Optimising nitrogen fixation of grain legumes—northern region
DAS00128	Optimising nitrogen fixation of grain legumes—southern region
DAV00113	Expanding the use of pulses in the southern region
DAW00213	Putting the focus on profitable break crop and pasture sequences in WA
DAW00221	Optimising nitrogen fixation of grain legumes—western region
DAW00227	Tactical break crop agronomy in Western Australia
GPC00001	Extension of Nitrogen Fixation Program outputs to end users—western region
PAL00019	Australian Broadleaf Cropping Project
UA00119	Assessing management options for enhanced soil phosphorus availability using rotations
UA00138	Extension of nitrogen fixation program outputs to end users—southern region
UQ00067	Queensland Pulse Agronomy Initiative to increase the reliability and yield of summer and winter pulses
VIC00010	Correct crop sequencing for irrigated double cropping

Theme 5—Improving your farm resource base

UWA00139	SBI II—Harnessing the nitrogen cycle through novel solutions
DAN00189	AIRG—National independent quality assurance and germplasm maintenance for Rhizobium inoculants
DAV00106	Managing soil biology to improve nitrogen supply in grain production systems
UMU00040	Maintenance of rhizobial germplasm resources (national)
US00065	Understanding the molecular basis for desiccation tolerance of rhizobia for improved survival on seed
DAN00145	National independent quality assurance and germplasm maintenance for Rhizobium inoculum

Theme 6—Building skills and capacity

GRS10026	Grains Industry Research Scholarship—Foyjunnessa (UA) Assesing management options for enhancing soil phosphorus availability using rotations
GRS10039	Grains Industry Research Scholarship—Monica Kehoe (UWA) Unraveling the cause of black pod disease of narrow-leafed lupin and developing a control solution
GRS10061	Grains Industry Research Scholarship—Robert Syme (CUR) Comparative genomics of necrotrophic fungal pathogens
GRS10258	Grains Industry Research Scholarship—Ella Brear (US) Charcterising potential symbiosome membrane proteins essential to the legume-rhizobium symbiosis
GRS187	Grains Industry Research Scholarship—Liza Parkinson (UMU) Investigating the method of action of plant growth promoting rhizosphere bacteria enhancing nodulation in legumes
IDA10508	Industry Development Award—Holmes Farm Consulting Pulse market and agronomic opportunities
UHS10226	Undergraduate Honours Scholarship—Cheryl Day (UWA) Economic impact of soil borne diseases over the entire rotation sequence
UHS10234	Undergraduate Honours Scholarship—Jasmine Hart (UF) Interactions of actinobacteria with rhizobia
UHS10356	Undergraduate Honours Scholarship—Michelle Low (UCS) PBA Health benefits of Australian pulses
UHS10360	Undergraduate Honours Scholarship—Kyle Reynolds (UCS) PBA Health benefits of Australian pulses
UHS10446	Undergraduate Honours Scholarship—King Yin Lui (CUR) Dissection of genetic factors affecting *Ascochyta lentis* pathogenicity and its interaction with lentil (*Lens culinaris*)
UHS10548	Undergraduate Honours Scholarship—Bonnie Hargreaves (UWA) Heritability of resistance to black spot disease in a field pea recurrent enrichment and association population (Pea-REAP)
UHS10659	Undergraduate Honours Scholarship—Candy Taylor (UWA) Understanding the role of floral integrator locus FT in controlling phenology in narrow-leafed lupin for future breeding
UHS10662	Undergraduate Honours Scholarship—Eleanor Readford (US) The effect of preceding rotation crop (wheat, mustard and chickpea) on the incidence of crown rot in wheat