AUSTRALIAN GRAIN

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FRONT COVER

Unlikely hi-tech bedfellows

CSIRO Scientist Dr Dong Han Seo, holds a piece of graphene film 'grown' from soybean oil. Graphene is the world's strongest material and has a multitude of applications.
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Editorial... Lloyd O'Connell

TAKE a well-deserved bow, grain growers of Australia. You've just delivered the biggest winter crop the country has ever produced. According to ABARES' latest *Crop Report*, silos, sausage bags, bunkers, grain bins – even holes in the ground – are bulging with more than 52 million tonnes of winter grains.

National wheat production for 2016–17 is estimated at a record high of 32.6 mt, barley at 10.6 mt and our third biggest canola crop is in the bin at 3.6 mt. These harvest numbers are about 15 per cent higher than the September ABARES' forecast which (happily) reflects a better than expected spring in many areas thanks to timely rainfall. Some regions had too much of a good thing with waterlogged crops while frost damage, particularly in some areas of Western Australia, also took its toll.

But the total 'wash-up' has been exceptional. The old winter crop production record was back in 2011–12 when 45.7 mt was harvested – this has been smashed by a whopping 15 per cent – and off about 350,000 fewer hectares than that sown in 2011.

To dig a little deeper into the numbers, national wheat production in the 2011–12 season was 29.9 mt at an average yield of 2.15 tonnes per hectare. In the record breaking season just gone, wheat production was 32.6 mt with yield averaging 2.52 tonnes a hectare – or a 17 per cent better yield than our previous best.

Canola has a similar story with the 2016 national average yield more than 10 per cent above that of 2011.

This tells us that we're getting better at growing our winter crops and given a favourable spring, some fantastic yields are possible. I've spoken to a number of growers who very cleverly grew 'European yields' across large areas of their farms.

Farm study tours in 2017

With your crops forging ahead, it will be a great opportunity to saddle up this coming winter/spring and see what innovative farmers in other parts of the world are doing to keep ahead of the game. Our two *Kropping the Klondike* tours are already fully subscribed for this year but we still have room on our UK & Ireland, South America and Asian tours. Call us on 07 4659 3555 or see *www.greenmounttravel.com.au* for full itinerary details.

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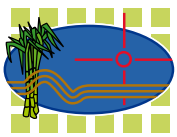

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Keep it simple when it comes to nitrogen

GROWERS should `keep it simple' when it comes to planning their nitrogen (N) fertiliser strategies for wheat and place more focus on N rate rather than application method and timing.

A series of 15 research trials conducted by the Grains Research and Development Corporation (GRDC) funded Northern Grower Alliance (NGA) over the past three years found that the rate of N applied was consistently the dominant factor affecting yield, grain quality and economic returns.

NGA has been heavily involved in projects focussing on N application strategies in wheat with the initial aim of assisting the management of high yielding – and frequently lower protein achieving – varieties such as EGA Gregory or Suntop.

Incorporate or spread urea?

One aspect of the research compared the impact of urea incorporation compared to surface spreading alone.

The results support the volatilisation work done by New South Wales Department of Primary Industries (NSW DPI) senior research scientist Dr Graeme Schwenke which indicated that the volatilisation losses from surface applied urea were frequently much lower than previously expected.

NGA chief executive officer Richard Daniel said the trial work consistently showed equivalent crop responses in terms of biomass, yield and grain quality from urea spread immediately post sowing, and with no physical incorporation, compared to the same rate of urea spread and incorporated by sowing.

"All sites were nitrogen responsive, with significant grain protein responses to nitrogen rate in all trials," Richard said.

"Across 22 comparisons of equivalent N application rates, the crop response has been the same regardless of whether we incorporated the urea at sowing or simply surface spread immediately after sowing.

"In 2015 and 2016 we also evaluated urea incorporated versus surface spread when applied during the fallow period.

Chief executive officer of the GRDC-funded grower group Northern Grower Alliance Richard Daniel.

Again, despite clear N rate responses, there was no significant difference in crop response between incorporated versus spread.

"That is not to say we aren't losing 'a quantity' of N via volatilisation when urea is simply surface spread. But it is indicating that the levels of loss have been low and were not sufficient to measure any difference in crop performance at any of the sites over the past three seasons."

In Queensland and NSW, growers typically apply nitrogen fertilisers such as urea directly into the soil (banding) or broadcast it on the surface then incorporate.

This is done to reduce the potential for those fertilisers containing ammonium (eg. sulfate of ammonia) or those producing ammonium (eg. urea) volatilising into the atmosphere as the gas ammonia.

Timing of N application

A range of N application timings were also evaluated as part of the research. A split application of N (50 per cent incorporated at sowing and 50 per cent spread at about GS30) was evaluated in all trials, while early and late fallow applications were included in 2015 and 2016.

Split applications of N performed more consistently than expected and provided equivalent crop responses to the same total quantity of N applied at sowing.

The results confirm that in-crop spreading can be a useful tool to capture upsides in yield and grain quality when seasons are favourable – but the practice is unlikely to become standard practice in the north due to the variable nature of late winter and spring rainfall.

Fallow N applications were evaluated in 2015 and 2016 and have generally provided equivalent results to the same quantity of N applied at sowing.

In trials where differences were evident, Richard said the impact appeared to be linked to other agronomic issues such as seedbed soil moisture disturbance (negative impact on establishment and yield) or breaking up of high stubble loads prior to planting (positive impact).

"A large focus of this work was to examine whether adjusting timing (or method) of N application could assist in the management of wheat varieties with low protein achievement," Richard said.

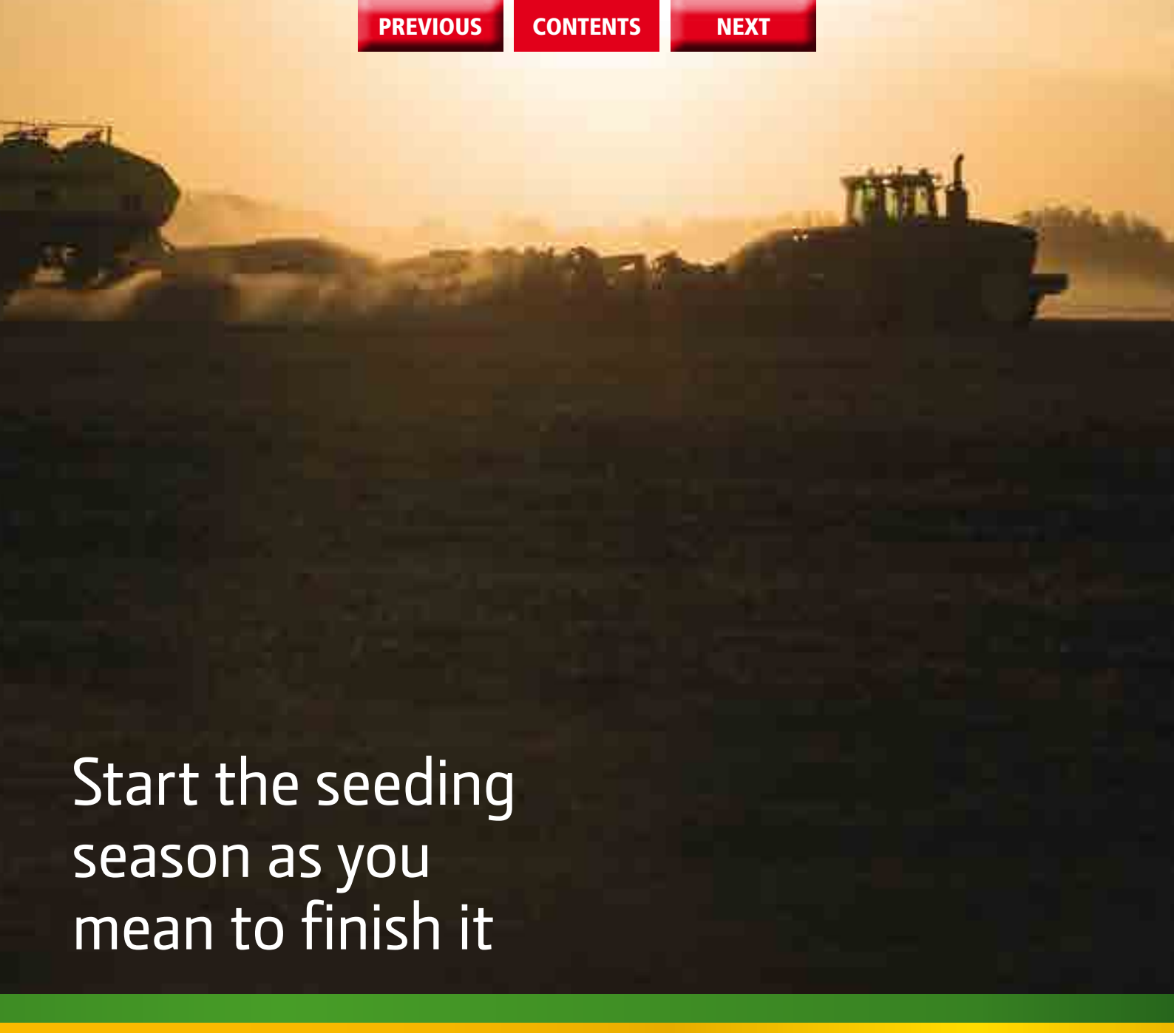
"Unfortunately the conclusions to date are that these tools are of minor impact with N rate the key driver. But the work has also helped to generate a large trial data set that indicates the losses from surface spread urea are much lower than previously expected.

Get the N rate right is the priority

"If there is one message to stress from this work, it is to keep N application simple. The benefits from adjusting timing and method appear relatively minor and growers may be better off applying when and where it suits other operations. Getting the N rate right appears much more important than timing or method."

"Another key message from this work has been that despite significant protein (and sometimes yield) benefits with increasing N rate, the highest net returns have nearly always been achieved from using 50 units of N per hectare."

For more information on NGA's trial work on N management, download a copy of NGA's 2015 and 2016 Update papers from the research and development section of the GRDC website www.grdc.com.au ■



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Soybean and graphene: Unlikely hi-tech bedfellows

AT A GLANCE

- A breakthrough by CSIRO-led scientists has made the world's strongest material – graphene – more commercially viable, and all thanks to the humble soybean.

GRAPHENE is a carbon material that is one atom thick – so what's this got to do with soybean? Until now, the high cost of graphene production has been the major roadblock in its commercialisation.

Graphene's thin composition and high conductivity means it is used in applications ranging from miniaturised electronics to biomedical devices.

These properties also enable thinner wire connections; providing extensive benefits for computers, solar panels, batteries, sensors and other devices.

Previously, graphene was grown in a highly-controlled environment with explosive compressed gases, requiring long hours of operation at high temperatures and extensive vacuum processing.

But CSIRO scientists have developed a novel 'GraphAir' technology which eliminates the need for such a highly-controlled environment.

CSIRO Scientist Dr Dong Han Seo, co-author of the study, holds a piece of graphene film 'grown' from soybean oil.

The technology grows graphene film in ambient air with a natural precursor, making its production faster and simpler.

"This ambient-air process for graphene fabrication is fast, simple, safe, potentially scalable, and integration-friendly," CSIRO scientist Dr Zhao Jun Han said.

Zhao is the co-author of a paper detailing this CSIRO graphene research published recently in *Nature Communications*.

"Our unique technology is expected to reduce the cost of graphene production and improve the uptake in new applications."

Enter soybean into this hi-tech world

GraphAir transforms soybean oil – a renewable, natural material – into graphene films in a single step.

"Our GraphAir technology results in good and transformable graphene properties, comparable to graphene made by conventional methods," CSIRO scientist and co-author of the study, Dr Dong Han Seo said.

With heat, soybean oil breaks down into a range of carbon building units that are essential for the synthesis of graphene.

The team also transformed other types of renewables – even waste oil such as those leftover from barbecues or cooking – into graphene films.

"We can now recycle waste oils that would have otherwise been discarded and transform them into something useful," Dong said.

The potential applications of graphene include water filtration and purification, renewable energy, sensors, personalised healthcare and medicine, just to name a few.

Graphene has excellent electronic, mechanical, thermal and optical properties as well.

Its uses range from improving battery performance in energy devices, to cheaper solar panels.

CSIRO are looking to partner with industry to find new uses for graphene.

Researchers from The University of Sydney, University of Technology Sydney and The Queensland University of Technology also contributed to this work. ■

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Researchers develop eco-friendly nanotechnology pesticide spray

By Marty McCarthy, ABC Rural

AUSTRALIAN researchers say they have developed a sustainable way to protect crops from pests and diseases, by spraying them with a special clay.

The discovery could also help the rural sector in the fight against pesticide resistance in certain crops.

The spray is known as 'BioClay' and was developed by the Queensland Alliance for Agriculture and Food Innovation (QAAFI) and the Australian Institute for Bioengineering and Nanotechnology (AIBN).

"It will produce huge benefits for agriculture in the next several decades, and the applications will expand into a much wider field of primary agricultural production," Professor Xu from AIBN said.

Agricultural biotechnologist and research leader, Neena Mitter, said the clay spray contained molecules that helped protect crops from invading pathogens.

"BioClay is a beautiful combination of biology and nanotechnology," she said.

"Once it is applied, the plant thinks it is being attacked by a disease or pest insect and responds by protecting itself from the targeted pest or disease.

"It is a [pest] control measure, which is environmentally sustainable, ecologically safe, stable, and easy to be adopted by farmers to protect their crop from diseases."

In the trials the researchers were able to protect a crop of tobacco from invading diseases for up to 20 days using the BioClay spray.

The team also trialled the spray on cowpeas and capsicums, and think it could also work for cotton and a range of other crops.

Chemical companies and researchers around the world, including Monsanto, are in a race to develop and commercialise similar technology.

But the QAAFI and AIBN team is the first to produce long-lasting results, and to have the findings published.

Professor Neena Mitter said she hoped to have a commercial product on the shelves in three to five years.

"There is a lot of work going on in using gene silencing in a spray, but I think we are fairly progressed in our own BioClay product," she said.

How it works

The clay contains molecules of double-stranded ribonucleic acid (RNA), a sibling of DNA, which can switch off gene expression and prevent plants from being susceptible to a virus.

The clay helps the molecules stick to the plant, and then peels off over time.

This means once a virus comes into contact with the RNA on the plant, the plant will kill the pathogen.

Using RNA as a defence against disease is not a new concept, and researchers have applied it to crops before.

But the new aspect is Neena's invention of the spray on clay to help bind the RNA molecules to the plant.

RNA is traditionally used to silence genes in the genetic modification process.

But Neena said her BioClay process did not genetically modify plants, because the process involved collecting RNA from a virus and turning it against itself, rather than changing the genome of a plant.

"We are using that RNA to silence a gene in the pathogen and that RNA has nothing to do with the plant, and has no similarity to the crop," she said.

"We are not modifying the genome of the plant, we are not doing genetic modification – we are just spraying it with RNA."

The researchers hope BioClay can be used as an alternative to traditional chemicals, to prevent crops from building up pesticide resistance.

"If you use a chemical, pathogens are clever and can adapt, but with BioClay we use RNA from the pathogen to kill the pathogen itself." Neena said.

"So we are strongly placed in terms of addressing the issue of pesticide resistance."

Can farmers afford it?

Finding a cost-effective way of applying RNA pesticides to plants has been difficult until now.

A criticism of using RNA to protect crops in the past has been that the technology was too expensive, but Neena said it was becoming cheaper and farmers would be able to afford it.

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Professor Neena Mitter has developed a clay-like spray that helps crops fight off pests and diseases. (Supplied by Queensland Alliance for Agriculture and Food Innovation and Australian Institute)

"The aim is to make it affordable because the clay part is cheap to manufacture," she said.

"The production of RNA could be expensive but companies around the globe are working on mass producing RNA at a very cheap scale.

"I'm hoping this product will be commercially viable." ■

The BioClay, containing RNA molecules, helps the RNA to stick to the plant. (PHOTO: University of Qld)

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Paddock selection for broadleaf crops in 2017

By Phil Bowden (Pulse Australia), Don McCaffery (NSW DPI) and Kurt Lindbeck (NSW DPI)

WITH the harvest finally over, attention now turns to fine-tuning planned crop rotations and making paddock selections that take into account the higher disease pressure confronted by many crops in 2016, due to prolonged wet conditions in winter and spring.

In particular, sclerotinia stem rot, a common fungal disease of broadleaf crops such as canola, that has become more prevalent in chickpeas and lentils, had an impact on crop yields in many regions and must be considered when selecting paddocks for broadleaf crops in the 2017 season and beyond.

Sclerotinia sclerotiorum, the fungus that causes sclerotinia stem rot, has a wide host range including many common broadleaf weed species and nearly all the broadleaf crops. Ideal conditions last season will have boosted inoculum levels in paddocks growing these crops and weeds. The main drivers of disease severity are the frequency and amount of late winter and spring rainfall, the length of crop flowering and how frequently a broadleaf crop has been grown in each paddock.

The survival structures of the pathogen are known as 'sclerotes' and can remain viable in the soil for as long as 10 years. Multiple rainfall events in late winter and spring in 2016 triggered germination of sclerotia and the subsequent release of air-borne spores, which infected flower petals and other plant parts, such as old leaves. Continued wet conditions allowed infected petals to cause stem lesions, and return more sclerotia to the soil. Direct infection of young plants can also occur, but is less common than petal and stem infection.

The fungus that causes sclerotinia stem rot has a wide host range of crops and weeds. (PHOTO: Kurt Lindbeck, NSW DPI)

Breaking the disease cycle

Breaking the disease cycle involves careful planning, particularly for high risk paddocks, including:

- Seed cleaning;
- Variety selection and sowing time;
- Foliar fungicide program;
- Crop rotation sequence; and,
- Soil and paddock drainage.

Seed cleaning

Sclerotes can end up in the header bin in seed retained to sow following crops. Grade oilseed and pulse seed used for sowing to remove sclerotes. Also apply a registered fungicide seed dressing at the same time to protect seedlings from seed-borne disease.

Variety selection and sowing time

There are no sclerotinia resistant crop varieties but variety selection is still important because the timing and duration of flowering are factors in disease development.

The timing of the commencement of flowering can significantly influence the susceptibility of pulse and oilseed crops to sclerotinia infection. Crops that commence flowering early (late June–July) are at a significantly higher disease risk. Flowers are emerging at a time of ascospore release from sclerotia and extended periods of leaf wetness, which are ideal for infection.

Early flowering also exposes the crop to multiple infection events and more opportunities for the disease to develop to damaging levels.

Follow the recommended sowing times for canola and pulse varieties best suited to your district. These recommended sowing times have been developed to optimise yield and minimise disease. Generally, early sown pulse crops are more prone to

Sclerotes from a North Star (northern NSW) chickpea sample showing irregular types typical of *S. sclerotiorum* with the atypical cylindrical types. (PHOTO: Gail Chiplin, NSW DPI Tamworth)

disease and frost injury. Early sowing exposes field peas to blackspot and bacterial blight, lupins are more prone to frost injury and chickpeas are more susceptible to sclerotinia stem rot.

Foliar fungicide program

Use of registered foliar fungicides to manage sclerotinia stem rot can assist in reducing the disease, but timing is critical for success. The recommendation for canola is to apply fungicide at 20–30 per cent bloom, when 15–20 flowers are open along the main stem. Fungicides are only effective for about three weeks, so timing is important to provide crop protection when the spores are released from the soil. Rainfall events during flowering can affect the result, so applications of fungicide need to be carefully planned.

Good coverage of the protectant fungicides on plant stems is required. For best results, use higher water rates and droplet sizes that will penetrate into the canopy.

Crop rotation sequences

The rotation sequence can help reduce the overall amount of inoculum in a paddock. With sclerotinia being such a widely hosted pathogen and with the sclerotes able to survive for up to 10 years in soil, getting a non-host crop or a less susceptible variety into the rotation can be one of the most effective cultural controls.

Inoculum levels can build up under some of the close cropped rotation sequences (eg. canola–wheat–canola). To minimise canola diseases such as blackleg and sclerotinia stem rot it is important to maintain a distance of at least 500 m between the canola crop and the stubble of canola or other susceptible crops.

Many foliar pathogens of pulse crops also survive in old stubble residue, ready to release spores the following year to infect emerging crops. Avoid sowing new season pulse crops adjacent to last season's pulse stubble.

A conflicting issue with rotations for disease management has been the use of double breaks with canola and pulses for herbicide resistant weed control.

Herbicide resistant weeds are the biggest problem in most cropping areas so alternate cultural controls have become more important, but disease inoculum often builds up when susceptible crops are grown in sequence. This is particularly important when conditions for disease are favourable, as witnessed in many regions in 2016.

Canola is the largest break crop for cereal crop weed management because of the numerous herbicide choices, but seedling canola crops do not compete well with some weed species, especially from within the brassica family – all potential hosts for sclerotinia.

Pulse crops also are a good choice when managing weeds as they can either be sprayed with selective grass herbicides or green or brown manured prior to weed seed heads appearing – but again are susceptible to sclerotinia.

The choice of rotation sequence crops is important and should be flexible enough to take into account the paddock history of weed species and resistance status, disease and insect pests, economics of the crop, and the benefits that crop will bring to future uses of the paddock.

Canola and pulse crops provide an opportunity to use different chemistry for weed control, which may assist in the management of herbicide resistance. But care needs to be taken when considering how diseases will affect the crops both in the current season and the future build-up of pathogen inoculum.

Soil and paddock drainage

Another paddock selection consideration is ensuring adequate soil and paddock drainage to avoid waterlogging. Most pulse and oilseed crop species have poor tolerance to waterlogging so be aware of soil types, paddock topography and the presence of hardpans that can promote waterlogging. Poor drainage exposes these crops to increased root rot diseases, such as phytophthora root rot, or premature crop death due to anaerobic conditions in the root zone.

***Sclerotinia sclerote* forming inside chickpea stem at Pallamallawa (TR8867) resulting in atypical, cylindrical shape.**
(PHOTO: Gail Chiplin, NSW DPI Tamworth)

For more information:
Pulse Australia: www.pulseaus.com.au
Australian Oilseeds Federation: www.australianoilseeds.com ■

Choosing the right pulse for 2017

Compiled by Don McCaffery Technical Specialist (Pulses and Oilseeds), NSW DPI and Pulse Australia

ANY choice about a pulse crop or variety will be influenced by several factors including location and rainfall, likely disease pressure, intended market and purpose within the rotation (eg. soil fertility, profit, weed control, forage): Australian pulse breeders have provided growers with a suite of varieties to suit wide ranging purposes and circumstances.

This article will assist with the identification of the pulse crops and varieties that best suit your farm in 2017.

CHICKPEA VARIETIES		
Northern region	**Southern region**	**Western region**
Desi	**Desi**	**Desi**
• Flipper	• Ambar	• Ambar
• Moti	• Genesis 508	• Genesis 510
• PBA Boundary	• Genesis 509	• Genesis 836
• PBA HatTrick	• Neelam	• Neelam
• PBA Pistol	• PBA Maiden	• PBA Slasher
• PBA Seamer	• PBA Slasher	• PBA Striker
• Yorker	• PBA Striker	**Kabuli**
Kabuli	**Kabuli**	• Genesis 079
• Genesis 425	• Almaz	
• PBA Monarch	• Genesis 079	
	• Genesis 090	
	• Genesis 114	
	• Kalkee	
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Desi types

PBA Boundary (2011): Moderately resistant (MR) to ascochyta blight (AB) but susceptible (S) to phytophthora root rot (PRR). Higher yielding (three per cent) than PBA HatTrick and Jimbour in northern NSW. Also an option for southern NSW where a tall, erect plant type is required, but is lower yielding than PBA Slasher in this environment.

PBA HatTrick (2009): Moderately resistant to PRR. MR to AB. High yielding, medium-seeded line to replace all previous varieties in northern NSW and southern Queensland.

A graphic illustration of PBA Seamer's resistance to AB (right) compared to Jimbour.

PBA pulse zones.

PBA Maiden (2013): Southern adapted variety with early to mid-flowering and maturity. Moderately resistant to AB, susceptible to PRR. Large seed targeted for whole seed markets.

PBA Seamer (2016): Resistant (R) to AB and moderately resistant to PRR. Similar yielding to PBA HatTrick in the absence of disease, but significantly higher in the presence of AB. Semi-erect plant type with good lodging resistance at maturity. Early to mid-flowering and mid-maturity. Not recommended for southern NSW where other current varieties are higher yielding.

PBA Slasher (2009): Resistant to AB and S to PRR. Medium-seeded line. Superior yield to all other varieties in the south.

Kyabra (2005): MS to PRR and S to AB. Tall, lodging resistant and high yielding variety with large seeds highly preferred for the direct human consumption market.

PBA Striker (2012): Southern adapted variety with earlier flowering and earlier maturity than PBA Slasher. Moderately resistant to AB, susceptible to PRR. Medium to large seeded variety. High yielding in short season environments.

Kabuli types

Genesis 090 (2005): Very susceptible (VS) to PRR. R to AB (may still need a pod spray in AB-prone areas). High yielding, small-seeded (mainly 7–8 mm grades) variety potentially well suited to southern NSW. Likely to command a premium over desi types.

Almaz (2005): VS to PRR. MS to AB, therefore requires multiple fungicide applications to control AB. Medium to large seeded (mainly 9 mm grades). May be suitable for southern NSW and northern areas where there is a low risk of PRR.

Genesis 425 (2006): S to PRR (but least susceptible amongst kabuli varieties) and R to AB (may still need a pod spray in AB-

The notes provided are very brief and are primarily aimed at production systems in NSW and Queensland. More extensive notes and links to the variety management packages are available in the 'Growing pulses' section of the Pulse Australia website.

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prone areas). High yielding, small-seeded (mainly 7–8 mm grades) variety for northern NSW. Higher sensitivity to Balance herbicide.

Genesis 114 (2010): VS to PRR. MS to AB. A tall erect, medium-seeded (mainly 8–9 mm grades) line potentially suited to southern NSW and northern areas where there is a low PRR risk.

Genesis Kalkee (2012): Large seed (mainly 9–10 mm grades). VS to PRR and MS to AB. A tall erect variety more suited to irrigation areas of southern NSW and northern areas where there is a low PRR risk.

PBA Monarch (2013): Susceptible to PRR and moderately susceptible to AB. Early flowering and early maturing (earlier than Genesis 090) and higher yielding than Almaz and Genesis Kalkee. Medium seeded (mainly 8–9 mm grades): Suited to southern and northern areas where there is a low PRR risk.

FABA BEAN VARIETIES	
Southern region	**Northern region**
• Farah	• PBA Warda
• Fiesta VF	• PBA Nasma
• Nura	
• PBA Rana	
• PBA Samira	
• PBA Zahra	
• PBA Kareema (broad bean)	

Northern NSW and southern Queensland

PBA Nasma (2015): Higher yielding than PBA Warda. Readily acceptable to the human consumption market. Its flowering and maturity time is similar to PBA Warda. PBA Nasma is similar to PBA Warda for resistance to chocolate spot and tolerance to frost and bean leafroll virus. Its rust resistance is slightly inferior to Doza, but far superior to Cairo.

PBA Warda (2012): Higher yield and bigger seed than Doza. Being superseded by PBA Nasma.

Southern NSW, Victoria and South Australia

While the newly released varieties have steadily improved disease resistance, none have complete resistance to rust, chocolate spot or ascochyta blight. In a disease favourable environment (because of frequent rain or high inoculum) yield losses will occur.

PBA Nasma is a faba bean readily accepted by the human consumption market.

Growers are therefore advised to adhere to the disease management package and apply a fungicide spray earlier in the season. This early spray can control the establishment of disease inoculum in the paddock and will therefore have a season-lasting effect.

Crops of Farah should be monitored carefully for the presence of ascochyta blight. A new pathotype of *Ascochyta fabae* emerged in the Mid North region of South Australia in 2013 and has overcome the resistance of Farah.

This new pathotype has not been reported in NSW, to date, but growers of Farah should be vigilant. Nura and PBA Samira remain resistant while PBA Rana and PBA Zahra are MS/MR to the new pathotype.

Nura (2006): More resistant to chocolate spot and rust than Fiesta and Farah, and similar ascochyta resistance to Farah. Nura is a shorter plant, with better standing ability than Fiesta and Farah, although will still lodge under extreme conditions. It is a later flowering type and best yields are obtained when sown early.

PBA Rana (2011): Medium to large seed, about 20 per cent larger than Fiesta and Farah and well suited to the Middle East market. PBA Rana has a greater level of resistance to ascochyta blight and chocolate spot than Nura and Farah, and is moderately susceptible to rust. Vigorous early growth and good stem strength and standing ability, although could lodge under very high biomass situations.

PBA Samira (2014): Very high yield potential. Resistant to ascochyta blight, and less susceptible to both chocolate spot and rust than Fiesta VF and Farah. It flowers at the same time as Nura and PBA Rana and matures at the same time as Fiesta VF and Farah. Reduced number of early stems and good standing ability. Acceptable to co-mingle with other varieties for the Middle East market.

PBA Zahra (2015): Is particularly responsive to high yielding situations. It is resistant to ascochyta blight in most districts in the southern region, although MS/MR to a new pathotype in the Mid North of South Australia. It is less susceptible to chocolate spot and rust than Fiesta and Farah. Flowers at the same time as Nura and PBA Samira, but can mature slightly later if seasonal conditions are conducive. Can be co-mingled with PBA Rana for a large seeded category in the Middle East market.

Farah (2004): Slightly later maturity than Fiesta. Farah is very similar to Fiesta but with improved ascochyta resistance and more uniform seed characteristics. The ascochyta resistance of Farah has been overcome by a new pathotype of *Ascochyta fabae* in the mid-north of South Australia.

Fiesta VF (1998): Medium seed size aimed at higher value human consumption markets. Medium maturity, susceptible to rust and chocolate spot, good early vigour. Is being superseded by varieties with improved disease resistance and more uniform seed characteristics.

FIELD PEA VARIETIES			
White	**Dun**	**Kaspa-type**	**Forage**
• Bundi	• Maki	• Kaspa	• PBA Hayman
• Moonlight	• PBA Coogee	• PBA Gunyah	• Morgan
• PBA Pearl	• PBA Oura	• PBA Twilight	
• Sturt	• PBA Percy	• PBA Wharton	
• SW Celine	• Yarrum		

For southern and central NSW, preferred varieties are PBA Oura, PBA Percy or PBA Wharton. In areas prone to bacterial blight, choose PBA Percy or PBA Oura. In areas prone to powdery mildew, choose PBA Wharton or Yarrum. For white peas, choose PBA Pearl or Sturt.

Morgan is the preferred forage/brown manure variety.

Maki is the variety for blue pea, but Excell is still grown in certain areas.

For the northern region, Yarrum and PBA Wharton are both powdery mildew resistant, the highest yielding and best performing varieties.

(All varieties susceptible to blackspot, bacterial blight, pea seed-borne mosaic virus (PSbMV) and powdery mildew unless otherwise stated).

Dun

Yarrum (2003): Yarrum is consistently among the top yielding commercial lines across northern and southern NSW. Dimpled dun pea, purple flowered, semi-leafless, medium height. Late flowering but fills pods and finishes quickly. Erect growth, tends to lodge at maturity. Resistant to powdery mildew, R to PSbMV, MR-MS to bacterial blight.

Maki (2008): Higher yielding, better disease resistance and better seed quality compared to Excell, but much shorter. Blue pea, green cotyledons, white-flowered, semi-leafless, medium height. Good resistance to bleaching, mid maturity. Resistance to powdery mildew, PSbMV and BLRV viruses. Will require management for blackspot, bacterial blight and downy mildew in disease-prone areas. Potential for niche blue pea market.

PBA Oura (2011): Early-mid flowering, erect, semi-dwarf, semi-leafless type with good tolerance to bacterial blight (*P. syringae* pv syringae). Note, PBA Oura does develop bacterial blight but is much better able to recover. Early uniform maturity, suited to crop topping. Broad adaptation and is one of the highest yielding varieties across all environments.

PBA Percy (2011): Very early flowering, tall, scrambling, conventional type with excellent tolerance to bacterial blight (*P. syringae* pv syringae), better than PBA Oura. Note, PBA Percy does develop bacterial blight but is much better able to recover. Purple flowers, dimpled dun seed. Broad adaptation and is one of the highest yielding varieties across all environments.

Kaspa-type

PBA Wharton (2013): Kaspa plant and seed type with the added advantages of earliness, resistance to PSbMV and BLRV viruses. Resistant to powdery mildew and higher tolerance to soil boron toxicity. Widely adapted across southern Australia and northern regions of NSW. Superior to PBA Gunyah and PBA Twilight.

White

PBA Pearl (2012): Early-mid flowering, erect, semi-dwarf, semi-leafless type. Broad adaptation and the highest yielding commercial variety across southern Australia. Early uniform maturity, suited to crop topping. Suited to human consumption or for stockfeed. Conventional pods, moderate resistance to pod shattering. Soft seeded, therefore no self-sown plants in following crops.

Sturt (2005): Conventional tall plant type, scrambling growth habit, early to mid-season flowering, small smooth round white seeds. A high yielding white pea in the drier production zones of NSW. MR-MS to bacterial blight.

SW Celine (2003): Main feature is its early flowering, early maturity and superior pod set. This gives it superior drought tolerance and a distinct yield advantage in dry seasons. Best suited variety to crop topping. Conventional pods requiring timely harvest to prevent shattering. MR-MS to downy mildew.

Forage

Morgan (1998): MR to bacterial blight. Very competitive with weeds, best choice for hay, forage, silage and green/brown

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manure, lodges at maturity. Holds up well in dry seasons and tight finishes because of its height.

LUPIN VARIETIES	
Albus lupin	**Australian sweet lupin**
• Amira	• Jenabillup
• Luxor	• Mandelup
• Rosetta	• PBA Barlock
	• PBA Gunyidi
	• PBA Jurien

Lupinus albus (broad-leaf or white lupin) types

Luxor (2005): Classed as resistant to pleiochaeta root rot, compared to Kiev-mutant (VS) and Ultra (MS). Luxor is especially suited to all low-rainfall and medium-rainfall areas. It is the variety of choice where pleiochaeta disease pressure is expected to be high (although it is not immune to the disease and good agronomy and suitable rotations should still be practiced). Luxor is susceptible to anthracnose (as are Kiev-mutant and Ultra) but that disease has not been found in NSW lupin crops. Luxor is 100 per cent 'sweet' (low-alkaloid) and has protein content and seed size similar to Kiev-mutant and Ultra. Suited to all existing albus lupin markets.

Rosetta (2005): Rosetta is moderately-resistant to pleiochaeta root rot (less resistant than Luxor, much better than Kiev-mutant, slightly better than Ultra). Is suited to high-rainfall, cool-season sites where maximum yields can be obtained. Rosetta is 100 per cent 'sweet' (low-alkaloid), and has good protein content and seed size. Suited to all existing albus lupin markets.

Amira (2012): An anthracnose resistant albus variety released for Western Australia. Anthracnose has not been found in the main lupin growing regions in eastern Australia. Amira was tested in NSW NVT trials for the first time in 2016.

Kiev-mutant (1982): Now outclassed. Existing seed stocks must be checked annually for bitter seed contamination.

Ultra (1976): Still a popular variety in central and northern NSW. Now outclassed. Existing seed stocks must be checked annually for bitter seed contamination.

Note: To maintain the seed quality standards for sweet albus (low seed alkaloid), growers are reminded to get their sowing seed tested for possible bitter seed contamination. Contaminated seed should not be used for sowing and must be delivered or used for feed. An ultraviolet lamp test is available which rapidly detects high-alkaloid ('bitter') seeds in a grain sample.

Growers can get seed tested through Futari Grain Technology Services (Ph: 02 6792 4588).

Lupin beans are 100 per cent bitter, must only be grown in isolation, and cannot be fed to stock.

Lupinus angustifolius (narrow-leaf lupin) types

PBA Jurien (2015): A high yielding, early flowering variety, with both phomopsis and anthracnose resistance. It also is tolerant to metribuzin herbicide.

PBA Gunyidi (2011): Replaces Mandelup as a high yielding narrow-leafed lupin variety with good resistance to pod shatter.

PBA Barlock (2013): It is resistant to anthracnose and tolerant to metribuzin herbicide. Yielding similar to Mandelup, it has good lodging resistance and moderate phomopsis resistance. It is shorter in height than Mandelup, with slightly later flowering and maturity. It has improved resistance to pod shattering over Mandelup.

Jindalee (2001): Jindalee is a late flowering variety and provides an early-sowing option after good April rains. High yielding in high-rainfall or long-season areas, combined with very good phomopsis resistance and excellent lodging resistance. It is susceptible to brown leaf spot, and has poor CMV seed transmission resistance.

Jenabillup (2007): Jenabillup has moderate resistance BYMV infection. BYMV can cause significant damage in eastern states when seasons are suitable, such as 2014. Jenabillup has performed very well in NSW. MR to anthracnose and intolerant of metribuzin herbicide. It is also MS to phomopsis stem infection.

Wonga (1996): The most anthracnose-resistant variety (although anthracnose is not present in NSW lupin crops): Earlier flowering than Jindalee but later than Mandelup, Quilinock and Jenabillup. Wonga has phomopsis resistance, brown leaf spot resistance, and CMV seed transmission resistance in good combination. Can be lower yielding than earlier maturing varieties in short seasons, and is intolerant of metribuzin.

Mandelup (2004): High yield, phomopsis resistance and large grain size. Moderately resistant to anthracnose. The earliest flowering and maturing of current varieties. Prone to frost damage if sown earlier than normal sowing window as it is a non-vernalising type. Tolerant of metribuzin herbicide. Prone to pod shattering if harvest is delayed after reaching maturity.

Quilinock (1999): High-yielding line with large seed size but now outclassed.

LENTILS	
Red lentil VMP	**Green lentil VMP**
• Nipper	• Boomer
• Nugget	• PBA Giant
• PBA Ace	• PBA Greenfield
• PBA Blitz	
• PBA Bolt	
• PBA Bounty	
• PBA Flash	
• PBA Herald XT	
• PBA Hurricane XT	
• PBA Jumbo	
• PBA Jumbo2	

Lentil varieties with ascochyta blight and botrytis grey mould resistance, including PBA Ace, PBA Herald XT and PBA Jumbo2, are suited to localities prone to foliar diseases.

PBA Blitz, PBA Bolt and PBA Flash are earlier maturing than some older varieties and suit shorter growing season areas or delayed sowing. PBA Hurricane XT, Herald XT, PBA Bounty are small-seeded red lentils that also handle a quick seasonal finish.

PBA Jumbo2 and PBA Jumbo have superseded Aldinga as large-seeded red lentils.

PBA Hurricane XT and PBA Herald XT are agronomically similar to Nipper but have improved herbicide tolerance to applied flumetsulan and residuals of some 'SU' and 'imi' herbicides.

PBA Greenfield and Boomer are medium-sized green lentils with improved seed size, growth and disease resistance over Matilda. Tiara, a long season green lentil with very large seed size, is not widely grown and is only suitable for spring sowing in high rainfall areas. PBA Giant is the only large-sized green lentil variety, which opens up new market opportunities for growers.

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Full descriptions of available pulse varieties, including most variety management packages (VMP) are available on the Pulse Australia website www.pulseaus.com. The NSW DPI Winter Crop Variety Sowing Guide 2017 will be published in April, including NVT performance data. ■

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On the scrapheap – nearly!

By Ian M. Johnston – Part 2

Previously, I described how Saint Peter considered me unworthy of entering his land of bliss, despite the fact that my heart reckoned the timing was right! But some re-plumbing by my cardiac guy got me going again and it looks like I shall be inflicting my presence on society for many years yet! Sorry about that.

But you know what they say? If your days are likely about to end, your life's experiences flash through your mind, in the manner of a fast forward DVD. Well I was treated to some of the more bizarre episodes I encountered during my decades of research into the history of farm tractors, some of which I recounted in Part 1 of this epistle. Here are some more of my trials and tribulations for your contemplation. As it happens, they each involve snow!

Montenegro 1988

Having spent several halcyon days exploring the antiquities of the medieval city of Dubrovnik, Margery and I then continued quietly motoring south along the spectacular Adriatic Highway. Our destination was the IMT tractor factory at the coastal city of Bar, close to the Albanian border.

Upon approaching Lake Kotor we had two choices. Put the car on the ferry for the crossing between the two headlands, through which the Adriatic Sea inlet flows and ebbs. Or circumnavigate this breathtakingly beautiful vast waterway, an involvement of several hours driving along meandering lakeside roads. We opted for the latter.

Even before our departure from Australia, we knew of the recent devastating earthquake which had created havoc in Montenegro. Around the shores of Lake Kotor, we passed through villages strewn with the skeletons of collapsed stone cottages, grim evidence of the destruction which had occurred only weeks before.

We eventually arrived at the township of Kotor to be told that, owing to repairs being carried out, there were no vacancies at the hotel. It was now approaching dusk and again we had two choices. We could either push-on around the lake and hope to find a hotel on the coast, or take what appeared on the map to be a shorter alternative – drive up the Mount Lovćen road to a town named Cetinje. Again we opted for the latter.

In fading daylight, we pointed the nose of the rental Zastawa up the mountain road. It was narrow, twisting and horrendously steep. Every few minutes, yet another hairpin bend had to be negotiated with extreme caution. There were no guard rails and the ever diminishing view of the lake fell vertically to our left.

But there was no need for alarm. I had dropped the little Zastawa back into second gear and it was coping adequately. So all was fine, until we entered a particularly sharp hairpin and observed to our horror that, as a result of the earthquake, half the road had collapsed and obviously plunged down into the lake! This realisation came as we had passed the point of no return into the bend! Wow! I gently eased the vehicle onwards and brought it to a halt, then walked back to inspect the situation.

As the realisation hit me of how close we had been to toppling into the abyss, there was a crashing sound as a hunk of road, the size of a grand piano, suddenly broke away and vanished from sight! Strewth!

It was now only twilight and we had no option but to push on. Abruptly the twinkling lights of Kotor, now several thousand feet below, disappeared as if someone had switched them all off. But in fact they had been blanked out from our vision by a thrashing rain storm which suddenly hit the car like a tornado! The darkness now engulfed us totally. The headlights of the Zastawa struggled to probe the road ahead. Things couldn't get any worse, could they? Well they did!

The Lovćen mountain road climbs to 5500 feet. As we

NO! This is not a Ferguson 35. It is Yugoslavian IMT 533, manufactured at Bar between 1961 and 1988, in southern Montenegro. It is powered by a Peugeot 40 h.p. diesel engine. (IMJ archives)

Lake Kotor. Note Lovćen Mountain is on the top right of the image.

A Zastawa police car, the same model as the author drove in Montenegro.

continued the ascent, now in first gear, the rain storm morphed into a raging snow blizzard! The combination of front wheel drive and no snow chains does not generate confidence in these circumstances, I can assure you. Had I stopped the forward motion, there is no way the tyres could have obtained sufficient grip on the treacherous black ice, now covered by a blanket of snow, to resume the climb. And the fuel gauge was rapidly approaching zero!

There was no alternative. We had to push on.

What seemed like a lifetime later, we crested the top of the range and descended down the Eastern slopes into the relative tranquillity of a valley. There never was a more welcoming sight for us than the lights of Cetinje. Soon we were luxuriating in the warm embrace of a fine traditional inn. Shaken but now relieved, our nerves were eased following an encounter with a couple of brandy and sodas and a large serving of Yugoslavian goulash with roast potatoes and Montenegro dumplings.

I made a resolution that in future I shall leave winter mountaineering to these Nepalese Sherpa guys and those yodelling chaps with colourful braces, one sees in Switzerland.


The dangerous road up Lovćen Mountain.

Pomeroy, Iowa 1997

In winter, the broad prairies of Iowa adopt a bleak drabness brightened only by the emergence of a homestead and its adjacent mandatory red barn. Thus it was, as we headed west across the Iowa grain belt, from our visit to the John Deere Corporate Headquarters at Moline, Illinois. Following an overnight stop at Fort Dodge, our destination was a farm a few miles from the whistlestop town of Pomeroy, where we had arranged to inspect a rare tractor with the unlikely name of Friday.

The Friday was credited as being the planet's fastest production tractor. Unfortunately, I was unable to experience the thrill of personally propelling this low flying missile across the countryside, as upon our arrival at the farm, the sullen sky opened up and preceded to dollop huge quantities of snow across the landscape. Within a couple of hours it lay a foot deep, including upon our rental Thunderbird!

But snow or no snow, we simply had to keep moving. We were due at Lincoln, Nebraska the following day, to keep an appointment with the Senior Engineer of The University of Nebraska Tractor Test Facility.

After being treated to a close inspection of the Friday, secure from the snow in its brick shed, we braved the weather in order to sweep away the mountain of snow, which by now enveloped our car. Once inside and the engine fired up, I gingerly pointed its long nose in the direction of the ramp, by which vehicles exited the farm yard enclosure, out onto the main road.

The landscape was totally white – and I mean totally! The ground met the sky, with no lines of demarcation. The snow flakes continued their blanket descent from aloft reducing visibility to a miserly few metres. I inched the Thunderbird towards the ramp, which was now completely obscured. And that is my excuse for missing the ramp and instead plunging Mr Hertz' Thunderbird headfirst into a deep ditch! How many people have seen a Thunderbird standing on its nose?

The Friday was trundled reluctantly from its place of repose


The Ford Thunderbird, as driven by the author.

and attached to the Thunderbird by a robust rope. Following several unsuccessful attempts, during which the tractor failed to obtain sufficient traction in the soft snow, the Friday eventually dragged the car from its undignified position. A close scrutiny revealed no damage, thanks to the cushioning effect of the soft snow. Indeed the only damage was to my not inconsiderable ego!

There is no doubt about it – being a writer of tractor stuff, certainly is a hazardous occupation!

The Scottish Highlands 2004

That morning we had disembarked from the St. Olaf, the vehicle ferry which plied between the Orkney Islands and the Scottish mainland. Our few days out on the islands included an inspection of the planet's most northerly tractor collection. But now we were swiftly heading south, through the still wintering Highlands, heading for The Scottish Agricultural Museum at Ingliston, near Edinburgh.

The rental Rover powered its way effortlessly through the glens, skirting Invergordon, Inverness and eventually onto the A939 leading to Ballater, Balmoral and Braemar. We paused for fuel at Braemar and importantly, to seek a local weather forecast.

We were becoming uneasy about the road ahead through the notorious Glenshee, which bisects the Cairngorm Mountains. We had been noticing the winter snow remained undisturbed on the higher ground and indeed also in the shadows of the lower glens. Disconcertingly, the further south and the higher we drove, the more abundant was the snow. I was well acquainted with the many tales of unsuspecting travellers who had frozen to death in this wild part of Scotland. Old wives' tales? Perhaps. Perhaps not!

I knew there was a snow gate just south of Braemar, which would be closed to traffic if there was indeed the likelihood of dangerous weather. So we pushed on. It was now around 5 pm and already the darkness had descended, hastened by the low snow laden sullen clouds.

We were halted by a uniformed ranger at the snow gate, which had been closed, effectively blocking the road into the glen. He wandered over to the car.

"Had ye bin a meenit earlier you could have got through" he said apologetically. "But I jist received wurd that further on it's snowin' pretty heavy, and with the ice ye ken, it's becomin' pretty tricky, so it is," he added shaking his head.

I inquired if other vehicles had recently been permitted to pass.

"Oh aye" he responded. "There are twa cars jist aheed. I suppose if yur in a hurry Ah could let ye gang through. But definitely yail be the last until at least the morn," he stated resolutely.

With that and a warning to take it slow, he opened the gates and waved us through.

I drove sensibly, mindful of the conditions. Flurries of snow were accompanied by the darkness, through which the headlights endeavoured to probe. I reduced the speed of the Rover as I peered ahead into the night. Visibility rapidly worsened as the snow increased in intensity.

Then it happened! Suddenly, a series of spectral phantom images flashed across the road, immediately in front of the Rover bonnet. With a reflex action, my foot slammed on the brakes.

Two things ensued. First – the Rover broadsided before sideslipping into the roadside ditch. Second – the phantom images resolved into being a convoy of Red Deer gracefully leaping across the road.

My heart sank as the seriousness of the situation penetrated my quivering grey cells. It was immediately obvious that, even with routine debogging tactics such as reducing tyre pressures, etc, there was no way, without a tow, the vehicle could ever be encouraged to clamber out of the frozen ditch.

Road closed, snowing heavily, darkness and the temperature plummeting. Gosh, what a nightmare! And what about the old wives' tales?

An hour passed, during which time Margery and I wrapped ourselves in layers of clothes and huddled together in the back seat. We'd be okay – wouldn't we?

A while later, there were some muffled sounds followed by a banging on the roof. A whiskered face almost hidden by a Balaclava, peered in through the frost encrusted window. A Department of Forestry Land Rover was already being attached by a rope to our vehicle. Thank God!!!!

Two hours later we were sitting beside a blazing fire, in a Blairgowrie hotel, consuming a very much appreciated nerve calming pint of Tennent's Lager, complimented by a steaming haggis with mashed totties and champed neeps, followed by a wee dram of Drambuie! All was well again!

Conclusion

Researching material for my tractor books and magazine articles, is fun – usually! Oh, and I really enjoy snow – usually! ■

The snow gates, blocking the entrance to Glen Shee.

IAN'S MYSTERY TRACTOR QUIZ

Question: Can you identify this tractor?

Clue: It is an export model.

Degree of difficulty: Challenging!

Answer: See page 48.

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Harvest rain impacts quality of sowing seed

HEAVY summer rainfall through some parts of the national cropping region could impact on the viability of grain that growers are planning to retain for sowing in 2017.

Any grain subjected to wetting at harvest is more susceptible to poor germination, low vigour and degradation during storage and handling.

Grains Research and Development Corporation (GRDC) Southern Regional Panel member Kate Wilson encourages growers to closely scrutinise seed being set aside for planting.

Kate, a grain grower and agronomic consultant in Victoria's Mallee, says it is essential that growers determine whether damage to grain caused by rain at harvest is purely cosmetic or the symptom of a seed-borne disease which will impact on germination.

"To ensure establishment of a healthy crop next season, it is important to pay particular attention to the seed that is being saved for sowing. Proper management of the seed starts at harvest and should continue right through to storage, handling and seeding next year," Kate said.

Grains Research and Development Corporation (GRDC) Southern Regional Panel member Kate Wilson encourages close scrutiny of seed being set aside for planting.

Some varieties more susceptible

She said growers should also be aware that some cereal varieties were more susceptible to the effects of late season weather damage. For example, the imidazolinone-tolerant Kord CL Plus wheat is rated as being susceptible to pre-harvest sprouting.

The symptoms of seed quality deterioration can range from mild, such as a loose and wrinkled seed coat in some pulses, to more advanced, such as seed staining, fungal mould and visible signs of germination.

Unless canola seed was harvested before any weather damage it should not be retained for sowing due to the vulnerability of canola's small seed.

Any retained seed should be graded and tested for germination and vigour. Testing for seed-borne disease is also recommended, especially with saved pulse seed.

Other key points to consider

- While a laboratory seed test should be used to establish the germination percentage of on-farm retained seed before sowing, especially if it has been weather damaged, a simple on-farm germination test can be done in soil. This will give a good indication of emergence and seedling vigour as at germination.
- Seed-borne disease generally cannot be identified from visual inspection so requires laboratory testing.
- Achieving and maintaining low temperature, humidity and grain moisture content for stored grain is even more critical if grain has been weather damaged. As weather-damaged seed deteriorates faster than sound seed, it should not be stored for more than 12 months.
- With many weedy pulse and cereal crops in a wet season, desiccation or crop topping often becomes necessary. Depending on timing and chemicals used, this could affect seed quality for sowing.
- Grain must not be retained for seed when glyphosate has been used in pre-harvest applications.
- Seedling emergence can be affected by sowing too deeply, cold or wet soil, some seed dressings and herbicides, and hard-setting soil. ■

RETAINING SEED FACT SHEET

To assist growers in determining whether grain is viable for sowing and what is an appropriate and effective seed management program, the GRDC offers a detailed Retaining Seed fact sheet.

The fact sheet can be viewed and downloaded via www.grdc.com.au/GRDC-FS-Retainingseed

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Protecting mungbean rhizobia

By Paul McIntosh, Pulse Australia

EFFECTIVE nodulation of mungbeans can fix about 60 to 70 kg N per hectare – sufficient to grow a one tonne per hectare crop. But if the rhizobial inoculant is not applied, or if the bacteria are exposed to high temperatures and die, this nitrogen will need to come from residual N reserves in the soil or from a pre-plant application of urea or Big N.

The survival of rhizobium bacteria is very low if the inoculant product is exposed directly to the hot sun and temperatures are above 33 to 35°C.

It only takes a few hours of exposure to the sun and high temperatures on the back of a paddock truck, or in seed bins ready for planting, for high levels of mortality to occur, rendering the inoculation process ineffective.

Even if you have grown mungbeans in the paddock in the past, you simply rely on a large enough population of the mungbean strain (Group I) of rhizobium being present in the soil.

Promoting rhizobial survival

Water injection into the seeding furrow using cool water of neutral pH is the best application method to promote rhizobial survival and efficacy. Avoid mixing inoculant with liquid fertilisers. Even though liquid fertilisers are a very desirable nutrient application option, rhizobia are very sensitive to pH and direct contact with elements such as copper and zinc.

Some farmers are now adopting the practice of applying nitrogen prior to planting mungbeans to make their planting operation very smooth and staff efficient.

Keep in mind that these nitrogen applications should be pre-

Well-nodulated mungbean seedling roots rely on effective inoculation with live rhizobia.

plant and not just at planting because a wetting front is required to push this relatively mobile nitrogen deeper into the soil profile, where the roots of the young mungbean plants are developing.

There is no sense applying nitrogen into dry-ish topsoil while the mungbean roots develop in a good moisture zone lower in the profile. This is particularly important in fast growing mungbean crops where there is very little time to fix a nutrient deficiency.

If you plan to use applied nitrogen rather than (or as well as) fixed nitrogen to meet the mungbean crop's needs, a nutrient analysis of the soil profile well in advance of planting will help avoid having a sad, nitrogen-deprived mungbean crop three to four weeks after planting.

There is no advantage in applying a high rate of nitrogen fertiliser and also applying inoculant, because rhizobia will only fix nitrogen effectively if the soil nitrogen levels are low. But if your applied nitrogen remains positioned in the drier top soil layer, then seed inoculation may still be very effective.

More about rhizobia survival

Rhizobium bacteria are able to live freely in the soil without a host for a time but generally only when soil conditions – especially pH – are favourable to their survival. Rhizobia and their host legume tend to have similar pH tolerance. Inoculation is generally recommended for pulses (other than lupins) grown on soils with pH below 6 ($CaCl_2$) or below 6.5 (in water).

In higher pH soils, rhizobia associated with all pulse crops can survive for several months without a host plant. Many growers choose to use inoculant every time they grow mungbeans to be sure that the crop will nodulate effectively and fix atmospheric nitrogen to at least meet its own needs.

High biomass crops and narrow row spacing promote increased nitrogen production through fixation, contributing more to the N-budget of the rotation.

For more information: www.mungbean.org.au ■

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Early action pays off in the war on weeds

IF nothing else, herbicide resistance is predictable, but efforts to prevent seed set do pay off, particularly if action is taken early.

NSW DPI weeds specialist Tony Cook says that growers are becoming increasingly aware of the potential impact of herbicide resistance on their farming operations and they are seeing the benefits that come from early and decisive action.

Many factors may influence the process but if an individual plant that is resistant to a herbicide sets seed, it is only a matter of time before a small number of resistant plants becomes an ever-increasing weedy patch.

Tony says that growers can build farming systems that have a level of 'immunity' to herbicide resistance.

"If growers concentrate on minimising or preventing weed seed set, they can win against herbicide resistance," he says. "The trick is to use a variety of means to keep weed numbers low and to keep pressure on seed set. If resistant plants are prevented from setting seed, then the problem is contained.

"Eight out of the 12 glyphosate resistant species in Australia are present in weed populations in NSW and Queensland, particularly near the state border," says Tony. "In this region resistant awnless barnyard grass, annual ryegrass, liverseed grass and feathertop Rhodes grass are the main problems."

NSW DPI weeds technical specialist, Tony Cook, has documented the strategies used on four farms to successfully patch-manage resistant weeds using a variety of weed control tactics over a period of at least five years.

Prevent weed seed set for five years

Tony interviewed four northern region farmers to find out what strategies they had used to successfully manage patches of these four glyphosate-resistant weed species. The take-home message from these four farmers was that growers can drive down weed seed banks through a strong commitment to consistently preventing weed seed set for at least five years.

"The costs associated with treating the patches is an additional expense but this pales in significance against the cost of doing nothing and allowing the patches to spread across paddocks and beyond," he says.

More details about the strategies used on each case study property can be found on the Weedsmart website, along with a webinar presentation by Tony.

Patch management

While glyphosate resistance is becoming more widespread across the region, many resistant populations are still in patches up to one hectare in size.

"This gives growers the opportunity to use paddock-wide tactics combined with more intense patch management in

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Glyphosate resistance in weeds is becoming widespread across the northern grains region, particularly around the NSW Queensland border. But these resistant weeds are often found in small patches, less than one hectare in size.

problem areas," says Tony. "Some growers have been successful in completely eradicating herbicide resistant plants from patches of one hectare or less through very focused efforts to prevent seed set."

Strategies such as full cultivation, optical weed detection, brown manuring, double-knocking, strategic use of pre-emergent herbicides, using livestock as the second knock and close attention to the removal of survivors have all been used in different situations to treat patches of resistant weeds. While some of these strategies are often applied across the whole paddock, some can be directly applied to the patch to minimise the cost while maximising effect.

"A shift in cropping rotation and well-timed use of paraquat in place of glyphosate is another useful strategy to drive down weed numbers for these key species," says Tony. "While spot spraying can be a good option, it is easy to miss the outlier plants in a small patch. The optical sprayers can give better coverage of the weeds and often involve an alternative herbicide to glyphosate. Including a second knock to remove survivors is key to success with this and all other weed control tactics."

Pre-emergents are good but...

"Pre-emergent herbicides are being used to good effect in the fallow, provided that growers are very aware that these herbicides generally achieve only 80 to 95 per cent weed control," he says. "To gain any benefit from these herbicides it is very important to manage the small number of weeds that are likely to survive the pre-emergent application. There are quite a few herbicide modes of action that have a residual activity and each needs to be applied correctly to achieve the best results."

"We know that routine use of glyphosate every year in the fallow will cause glyphosate resistance in the weed population within 15 years if no follow-up action is taken to remove survivors," he says. "This has been demonstrated in trials and is evident in the field. It may then take another five or six years for the glyphosate resistant weeds to dominate in a paddock, again if no follow-up action is taken."

Be aware of new weeds

The spread of resistant weeds across a paddock or around the farm is quite easily done through movement of vehicles, machinery, people and animals as well as wind and water flow across the paddock or along irrigation channels.

Tony says being aware of new weeds on the farm, such as feathertop Rhodes grass deposited on farms around Dalby during flood events over the past few years, growers can get on the front foot with effective tactics such as double knocking before the new weeds are firmly established.

"Glyphosate resistant patches are frequently associated with fencelines and other non-crop areas on the farm and can spread into cropping fields," says Tony. "Identifying alternate strategies for managing these areas needs to be a high priority on all farms, even if glyphosate resistance is not yet evident."

For more information about patch management strategies to help manage herbicide resistance, visit the Weedsmart website: www.weedsmart.org.au

WEED smart
every weed every seed
every farm every year

Ramp up the competition in summer crops

THE higher rainfall across many grain growing regions in 2016 is providing farmers with more opportunities for summer cropping. Weeds also stand to gain from the additional soil moisture putting additional pressure on summer fallow spraying programs.

Dr Bhagirath Chauhan, Principal Research Fellow with the Queensland Alliance for Agriculture and Food Innovation (QAAFI) says agronomic trials measuring the effect of early canopy closure in summer crops are consistently resulting in lower weed biomass and higher crop yield.

"Our research in mungbean, cotton and soybean have shown that more even plant spacing across the paddock is more important for weed suppression than increased seeding rate, and this is best achieved through narrower row spacing," he says.

"In cotton, we demonstrated a clear benefit in planting at 50 cm row spacing rather than the conventional 100 cm spacing however, the limitation for growers is the inflexibility of the current harvesting equipment."

One configuration that has shown promise internationally – but not yet fully investigated in Australia – is the ultra-narrow row (UNR) concept where the beds remain at 100 cm spacing to suit the harvester but two rows of cotton are planted either side of the bed, effectively shading the inter-row earlier than a single row planting. The ultra-narrow rows are planted 19 to 38 cm apart on the bed and seeding rate is usually increased slightly.

Alternative chemistry

With limited options to increase crop competition in cotton, and the widespread adoption of Roundup-Ready (RR) technology in the industry, there is now a focus on finding alternative herbicide chemistry to manage the risk of glyphosate resistant weeds in cotton systems.

Bhagirath says growers are achieving good weed control with the pre-emergence herbicides recently registered for use in cotton. "The biggest challenge with these herbicides is getting the application right, taking into account the effect of rainfall, irrigation type and timing and the soil type," he says. "There are emerging weeds such as feathertop Rhodes grass, sesbania and amaranth that are challenging the Roundup-Ready cropping system and so growers need to have other weed management tactics in place early."

The cotton industry is promoting the adoption of the 2 + 2 + 0 weed management system to protect glyphosate and the Round-Up Ready hybrids.

This entails the use of two non-glyphosate herbicide options, two non-herbicide tactics and zero weed survivors.

Re-introducing the use of pre-emergent herbicides in cotton farming is an important part of this weed management program. Increasing crop competition is also worth further investigation given the potential weed control and crop yield benefits to be gained if the limitations of current harvesting equipment can be addressed.

To maintain yield in cotton it is important to restrict all weed management operations to the early stages of crop growth – a distinct advantage of using pre-emergent herbicides to minimise weed growth prior to crop canopy closure.

Crop competition

Peter Newman, communication lead with Australian Herbicide Resistance Initiative, has long been an enthusiastic advocate of crop competition in cereals. He says the recent findings in summer crops provides growers with a valuable non-herbicide tool they can use to help suppress weeds.

"Over and over we are seeing results come from crop competition trials showing suppression of weed biomass in competitive crops, and usually a yield benefit," Peter says. "This is a win win for growers and needs to become standard practice in all crops – not only regarding row width but all agronomic practices that boost early crop growth and result in early canopy closure."

For more information about achieving crop competition in summer crops to help manage herbicide resistance, visit the Weedsmart website: www.weedsmart.org.au ■

Agronomic trials in mungbean consistently result in improved yield and reduced weed biomass when crops are sown in rows 50 cm apart or narrower.

Value-added use for peanut skins

By Rosalie Marion Bliss, (formerly) Agricultural Research Service – USDA

AT A GLANCE

- Peanut skins are a processing waste product.
- Peanut skins are rich in plant compounds called polyphenols.
- ARS scientists have made a food ingredient from peanut skins whch increased polyphenol levels in milk chocolate without affecting flavour.

DARK chocolate is touted for its higher levels of plant-based cocoa bean than milk chocolate – but that does not mean chocolate lovers enjoy milk chocolate any less. Love of milk chocolate is mostly about the great taste from added fats, sugars, and creams versus dark chocolate's higher levels of defatted cocoa powder known as cacao.

Now, ARS–USDA researchers in Raleigh, North Carolina, have reported that consumers can enjoy the taste of milk chocolate that contains similar levels of plant compounds known as 'polyphenols' as found in dark chocolate.

For the new study, ARS researchers increased the levels of phenolic compound in milk chocolate to levels equivalent to those of dark chocolate without negatively affecting the flavour.

They achieved the boost by adding an ingredient extracted from something usually considered as waste – peanut skins.

Plants protect themselves against stressors by forming chemical compounds that include polyphenols. Both cocoa and peanut skins are rich in polyphenols – although it is unknown at this time if polyphenols from peanut skins and cocoa are equally bioaccessible (meaning in ability to release from food) or equally bioavailable (meaning for use by a consumer).

A peanut skin extract developed by US researchers can increase milk chocolate's polyphenol level without affecting flavour. (PHOTO: Peggy Greb)

Used to be considered a waste product

Peanut processing around the world removes thousands of tonnes of peanut skins each year, which are generally considered little more than a waste-management problem.

The ARS scientists developed a process to turn peanut-skin extract into a powder that can be used as a food ingredient.

Food technologist Lisa Dean, with the ARS Market Quality and Handling Research Unit in Raleigh, North Carolina, headed the study. Co-authors include Brianna Hess and Claire Klevorn, both with North Carolina State University in Raleigh.

The team extracted peanut-skin polyphenolics and treated them for use as an ingredient in a variety of foods, including chocolate.

When added to milk chocolate, the peanut-skin powder increased the levels of polyphenols in milk chocolate to those of dark chocolate without making it bitter. This is important because evidence indicates phenolics may impart a bitter taste, and theoretically, plants with relatively high levels of phenolics can potentially taste the most bitter.

"We used food-grade maltodextrin, which is a sugar compound, to create the powder, which decreases the bitter taste of the food ingredient," says Lisa. Volunteers who sampled a milk chocolate optimally enriched with the peanut-skin powder and a 'regular' milk chocolate did not have a preference.

"While we have studied bioactivity of the extract in cell-culture and test-tube studies, more research is required to gauge whether there is a measureable benefit from consuming foods enriched with this extract," says Lisa. "Allergenic effects of the extracts would have to be thoroughly evaluated before inclusion in any foods, and labeling would have to emphasise the addition of peanut products."

More information: Lisa Dean, Market Quality and Handling Research – Food Technology, USDA
Email: lisa.dean@ars.usda.gov – Ph: +1 919 515 9110.

■

Sorghum impresses with quick emergence

AFTER seeing his Pioneer brand G44 hybrid sorghum emerge up to five days quicker than other varieties, southern Queensland farmer Mick Ryan knew he was onto a good thing at the start of the 2015–16 cropping season.

Mick, who farms on 'Rymac' at Allora, grew G44 for the first time last season, planting a 10 hectare trial of the variety.

He spread his risk by introducing a new variety with similar characteristics to his existing sorghum.

"I've only ever grown one kind of sorghum, but we didn't want to continue putting all our eggs in one basket with a single variety," he says.

Mick says the performance of the G44 has given him confidence to plant the variety in a commercial quantity in the 2016–17 season.

Mick turned to G44 after it being recommended as having the same characteristics as his existing sorghum.

"I look for good stress tolerance for both hot and dry conditions in my sorghum, as well as good stooling and standability," he explains.

Mick planted a 160-hectare sorghum program in 2015–16 into mostly black creek soils, with 10 hectares sown to G44.

The G44 was planted with good sowing conditions on November 18, 2015 on a full profile of moisture.

Before planting, the paddock received 100 kg per hectare of urea and 40 kg per hectare of Gran-am, as well as Dual Gold for grass control.

"The G44 had really good emergence and vigour, it was out of the ground first and up to five days ahead of some other varieties, so it really surprised me.

"Normally after a week you see the odd plant emerging, but after a week there were definite rows of G44 out of the ground.

"The crop never looked back, and there was no insect pressure on it, so we never had to look at it really. The less time you can spend on a crop the better!" he says.

Sorghum harvest took place in mid-April 2016, with the crop standing up well for the header.

While the average G44 yield of around 7.5 tonnes per hectare was comparable to neighbouring sorghum, the variety shone on lighter soil.

"Where we had some lighter creek soil it outperformed its competition, maintaining its yield when the other varieties dropped off really badly.

"The G44 handled stress better and also produced a nice red grain of a good size. It was a lot redder than what we normally have," he says. ■

The 'push/pull' sorghum market

■ By Peter McMeekin, Nidera Australia Origination Manager

THE huge area sown to chickpeas last year and the relatively low forward price for sorghum compared to previous seasons, has seen a 25–30 per cent reduction in the area forecast to be planted to sorghum in the 2016–17 season. But the price of sorghum is high relative to its competitors into the domestic feed ration.

This is leading to a push/pull scenario between production and demand. On one hand planted area is being reduced as the price is not encouraging growers to maintain or increase planting intentions and on the other hand, the domestic consumer is removing sorghum from rations altogether (feedlots) or reducing inclusion rates, as the price is high relative to cereals (poultry and pork).

Ethanol mandate to make a difference... maybe

The one area of demand that is increasing to a small degree is the ethanol sector, driven by the ethanol mandate that came into effect in Queensland on January 1. The big question here will be how heavily it is policed and enforced in Queensland, as there has been a similar mandate in NSW for many years, but the demand there falls well short of the mandate expectations.

The wash up is production will most likely be down 25–30 per cent, with domestic demand down by a similar proportion. That will still leave a large exportable surplus, which needs to move into an export market that is spoilt for choice when it comes to feed grains.

So how are we priced from an export viewpoint? How do we engage the export consumer?

In US dollar terms, Australian sorghum is expensive. Save for minor parcels of container business into the alcohol sector, China is simply not engaging the Australian market at these prices. The domestic price premium over sorghum out of the US Gulf says that Australian sorghum is just too expensive.

Based on current production estimates two scenarios have to play out here.

- Either global feed grain values have to increase (unlikely due to aforementioned surpluses); or,
- The price of Australian sorghum must decrease to buy meaningful export demand.

Report issued January 10, 2017. ■

Chinese market looking bright for sorghum

WITH an aim to capture opportunities in the Chinese market, northern NSW farmer Simon Upton was after a sorghum variety with a bright colour.

The reason is that bright red sorghum grain is coveted by the Chinese market, and meeting this requirement would allow him to capitalise on the growing opportunities there.

Simon is farm manager for Unibale, which is owned by a Chinese company and situated west of Moree in northern NSW.

He ran a 220-hectare sorghum trial over the 2015–16 summer to assess four varieties, a third of which was Pioneer brand G33 hybrid sorghum.

"The ground was watered up and we planted into a full profile in early September 2015 at a rate of 2.5 kg per hectare – emergence was excellent across all the varieties, with plants coming up within seven days," Simon explained.

"We put down about 250 units of nitrogen just prior to planting and watering up, while weed control consisted of Dual Gold and atrazine, with no need for any other sprays throughout the season."

The trial received no significant in-crop rain, although G33 was amongst part of the trial that did get a second watering at the boot stage. Simon said at that point it was obvious the G33 grain fill was progressing well, meaning its yield potential was high.

"As we got closer to harvest – when we were comparing the G33 to the other varieties in the trial – you could tell it had the better potential due to the size of the heads and grain.

Excellent hectolitre weight

"That was confirmed when we harvested and our grain weights came back – which were up to 85 kg per hectolitre," he says.

With no lodging issues in the variety, Simon was pleased with how the G33 harvest progressed.

"The colour of the G33 was great and it yielded around seven tonnes per hectare, which was a fantastic result.

"We've made a conscious decision that from now on when we grow sorghum it will only be G33, as we know it's got the ability to hang on when conditions get a bit tough.

"After I sat down and worked out the return on the crop, it was pleasing to see that if you've got irrigation water, and you don't need as much as you do for cotton, and you can get these kinds of yields, it's a pretty handy return," he concluded. ■

Blake Phillips and Simon Upton are targeting the Chinese market with a bright red sorghum variety.

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AHRI insight...

Chaff carts – good for the crop and the sheep

AHRI AUSTRALIAN HERBICIDE RESISTANCE INITIATIVE

SO often in life, there are things that conflict with one another. Take the Australian cricket team for example. Social media is great for the social lives of the players, but it is disastrous for their batting. You simply can't bat all day in a Test match when you have the attention span of a goldfish!

Farming is just the same. There are conflicting farming practices. Often what is good for the crop is detrimental to the sheep, and vice versa.

Until now.

The humble chaff cart is good for both the crop and the sheep. Ed Riggall is a Western Australian-based farm consultant from AgPro Management. Ed specialises in livestock management and was frustrated that there was no data to evaluate the grazing of chaff dumps. Without funding, Ed set up trials at four locations in southwest WA in 2015/16 and got some great results. Essentially, the sheep did very well when grazing chaff dumps, particularly in canola stubble.

Suitable for most farming systems

But won't the sheep just spread the weed seeds back over the paddock? Fortunately, the answer to this question is no.

Chaff carts are a great tool for mixed farmers to feed sheep and smash their weed seed bank at the same time.

Sheep grazing on chaff dumps can have several benefits.

Almost every grain farming system in Australia is suitable for a chaff cart. Low rainfall, high rainfall, continuous crop, mixed farming – it all works. But it seems now that the greatest fit for the chaff cart is a mixed farming system that includes sheep.

Trialed across four sites

AgPro Management set up trials at four sites in the WA wheatbelt – Tenterden, Kojonup, Darkan and Cranbrook. Paired paddock trials were set up at each site, directly comparing sheep

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where a chaff cart was used to sheep where a chaff cart was not used, in otherwise duplicate conditions. The paddocks were analysed for feed quantity and quality prior to the trial and all sheep were weighed and condition scored fortnightly throughout the trial.

Grazing chaff dumps wins at all sites

Figures 1 through 6 show how the sheep grazing chaff dumps did better than the sheep without chaff piles in terms of weight at all four sites. Condition scores are also available from Ed Riggall if you would like to look at the data more closely.

Results from these trials show that investment in a chaff cart is very much worthwhile – even in a wet summer.

The trials were affected by early rains, which reduced the quality of feed in the chaff piles and stopped sheep from feeding.

The Cranbrook trial took place later in the season (March/April as opposed to December/January), so the chaff piles had been left exposed to rain for several months post-harvest, which is likely to have affected the quality of feed.

All of the sheep on the chaff piles had gained more weight than the sheep without chaff piles at the end of the trial.

Chaff dump feed quality analysis

There is money in grazing chaff dumps.

The weight difference observed can be converted into money saved on supplementary feeding to get the sheep without chaff piles up to the same weight as the sheep without chaff piles.

Ed used analysis of a typical, model farm – 2000 hectares, 50 per cent crop, 9.5 DSE per hectare – and found there would be an average saving of over $29,000 per year and an Internal Rate of Return on Investment in a chaff cart of 36 per cent per annum over 20 years. These numbers are based on evidence from the 2016 season, which was detrimentally wet.

More lambs

The farmers at Kojonup and Cranbrook recorded the individual

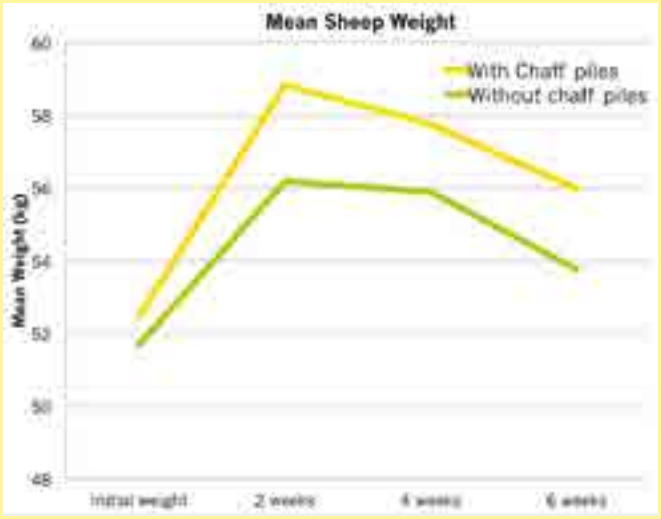
FIGURE 1: Tenterden – live weight of sheep grazing barley chaff dumps compared to grazing paddocks without chaff dumps

There was 87 mm of rain which fell at the beginning of the trial and a further 24 mm of rain fell five weeks into the trial.

FIGURE 2: Kojonup – live weight of sheep grazing canola chaff dumps compared to grazing paddocks without chaff dumps

18 mm of rain fell at the two-week stage of the trial and a further 97 mm of rain fell eight weeks into the trial.

FIGURE 3: Darkan – live weight of sheep grazing oat chaff dumps compared to grazing paddocks without chaff dumps



87 mm of rain fell at the beginning of the trial.

FIGURE 4: Cranbrook – live weight of sheep grazing wheat chaff dumps compared to grazing paddocks without chaff dumps

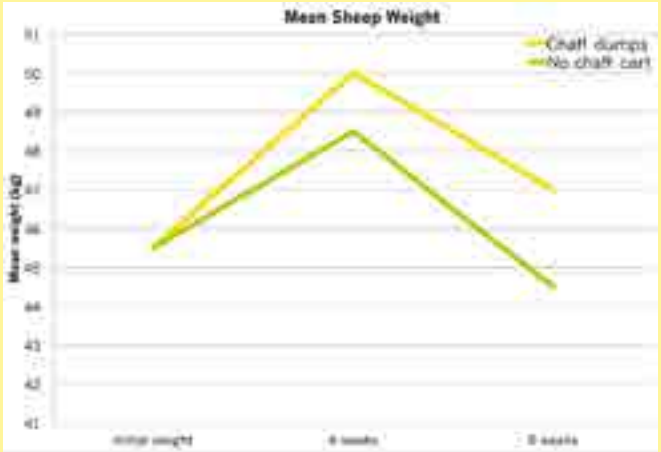
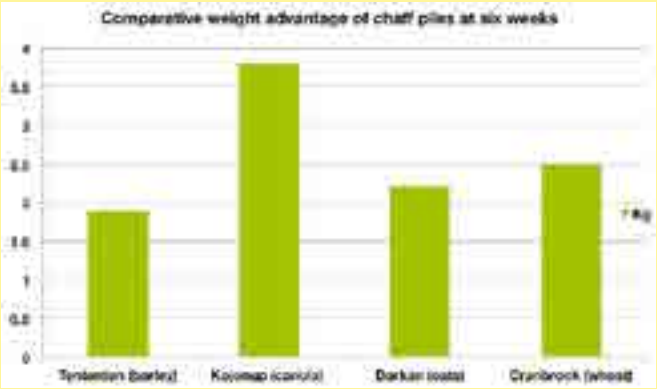


TABLE 1: Kojonup and Cranbrook lambing percentages from ewes on chaff piles compared to ewes without access to chaff piles

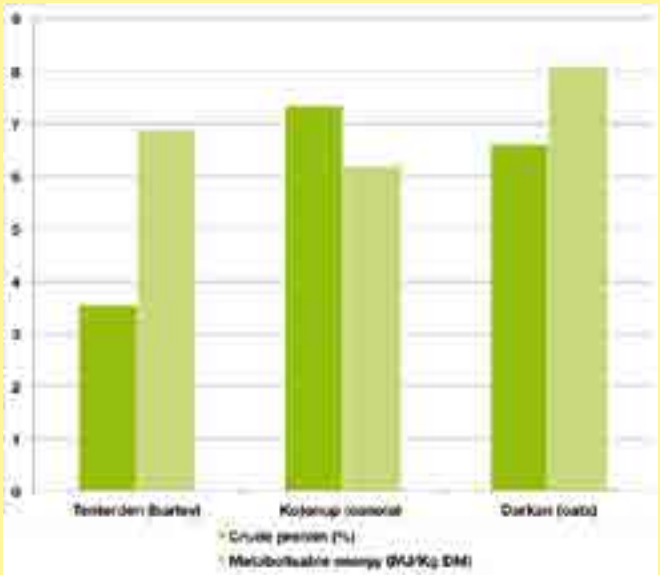
	Site	Ewes with chaff piles				No chaff piles			
		Singles	Twins	Dry	Total	Singles	Twins	Dry	Total
No. ewes	Kojonup	20	21	3	44	29	11	4	44
	Cranbrook	48	40	12	100	46	37	17	100
No. lambs at scan	Kojonup	20	42	0	62	29	22	0	51
	Cranbrook	48	80	0	128	46	74	0	120
% lamb potential at scan	Kojonup				141%				116%
	Cranbrook				128%				120%

FIGURE 5: Weight (kg) advantage of sheep (measured at the six-week stage of the trial) that had grazed chaff dumps over and above those that did not



These trials were also supported by Icon Agriculture who collected the Darkan data and Allflex Tags who provided EID tags.

FIGURE 6: Crude protein (%) and metabolisable energy (MJ/kg DM) feed analysis from chaff dumps at Tenterden, Kojonup and Darkan



scanning results for ewes tagged in the trial. The lambing percentage was 25 per cent higher in the ewes that had been on the chaff piles at Kojonup and 8 per cent higher at Cranbrook (Table 1).

This adds another element of real value to the use of chaff carts. This is consistent with the results of previous trials – most recently the Lifetime Wool trial – showing that ewe productivity is higher in heavier sheep with higher condition score.

To sum up

This is a single year of trial data in a year with a very wet summer which is likely to have had a negative impact on chaff dump grazing.

Yet the results of sheep grazing chaff dumps were very encouraging.

Hats off to Ed Riggall for undertaking this work without any funding. The chaff cart is one of the few examples of a tool that is good for both the sheep and the crop, and for this reason chaff carts are likely to have a long future in Australian cropping. ■

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Testing can guide plan of attack against nematodes

KNOWING which nematode species or root disease is present in a paddock – and at what levels – is important to help fine-tune crop rotation and variety decisions for 2017 to help break pest and disease cycles.

Department of Agriculture and Food (DAFWA) researcher Sarah Collins conducts nematode research funded by the GRDC.

She said that if nematodes or root diseases were suspected, it was advisable to correctly identify the cause and make a plan for next season – as there were few options for in-crop management.

Symptoms of root disorders

"Patches in paddocks, increased weeds, uneven and stunted plant growth, yellowing of plants and wilting or death under water stress – particularly at flowering and grain fill stages – can indicate the presence of root disorders in crops," Sarah said.

"But correct identification of root lesion nematodes (RLN) – the main nematode species affecting WA crops – as well as common root diseases, like rhizoctonia and take-all, can be achieved by soil testing, coupled with visual assessment of the root and hypocotyl of affected plants."

Sarah said the incidence of RLN was increasing across the grainbelt and GRDC-funded research by DAFWA as part of a 'Focus Paddock' project (which was completed in 2015), indicatedmore than 5.5 million hectares of cropped area in WA alone was infested with RLN.

Surveys in recent years have shown that 50 per cent of paddocks across WA's grainbelt have medium to high risk of up to 50 per cent yield loss due to RLN damage.

"Reports from the field in 2016 were that RLN continued to be damaging and advisers have identified this pest as a major cropping issue," Sarah said.

She said soil testing and monitoring could be conducted year-round through the South Australian Research and Development Institute (SARDI) PreDicta B service.

Correct testing procedure

The quality of results can be assured by sampling in the row of the previous season's crop, keeping samples at room temperature and sending samples to SARDI within two weeks of collection.

Plant and soil testing and monitoring can be carried out through DAFWA's Diagnostic Laboratory Services (DDLS)-Plant Pathology (formerly AGWEST Plant Laboratories) to help to correctly diagnose, monitor and manage nematodes and root and hypocotyl diseases in a range of crops.

"But DDLS must check for RLN in-season as, during summer, the nematodes desiccate and DDLS testing protocols rely on the presence of active nematodes," Sarah said.

She said that when considering crop sequences for next year, lupins could be a good management tool for reducing the nematode species *Pratylenchus neglectus* and *P. quasitereoides* (formerly known as *P. teres*).

"But lupins are very susceptible to damage from *P. penetrans*, highlighting the importance of correct species identification," Sarah said.

"DAFWA research also shows that liming of soils with low pH levels is another important tool to ameliorate potential RLN damage.

"Controlling weeds and volunteers pre-season can also help to reduce plant parasitic nematode levels."

Sarah said using resistant or tolerant crop varieties or non-host break crops and pastures could help to inhibit RLN reproduction and build up (resistance) and potentially boost crop yields to non-limiting levels under RLN pressure (tolerance).

This information can be found in Crop Variety Guides for WA at https://grdc.com.au/C/r/cropvarietyguide.

Information about RLN can be found at the DAFWA website (https://agric.wa.gov.au/n/2166) and in the GRDC Root Lesion Nematodes Tips and Tactics publication for WA (http://www.grdc.com.au/TT-RootLesionNematodes) which includes contact details for the PreDicta B and DDLS-Plant Pathology services. ■

The effect of root lesion nematodes (right) on wheat. (PHOTO: Evan Collis Photography)

European lessons shared on fungicide resistance

LEADING Danish researcher Lise Jorgensen will be a keynote speaker at Western Australia's premier grains research forum, providing advice on how growers can manage the growing issue of fungicide resistance.

Lise is a senior scientist at the Department of Agroecology at Aarhus University (Flakkebjerg).

Her talk will take place on the second day of the Grains Research and Development Corporation's (GRDC) Grains Research Update, Perth, to be held at the Crown Perth on February 27 and 28.

'Living with fungicide resistance – lessons for WA grain growers' will be presented in conjunction with Fran Lopez-Ruiz, of the Centre for Crop and Disease Management (CCDM) at Curtin University.

Danish researcher Lise Jorgensen will address the growing issue of fungicide resistance at the GRDC Grains Research Update, Perth.

Fran leads the Fungicide Resistance Group at the GRDC-supported CCDM, which conducts cutting-edge crop disease research into genetics, breeding and fungicides and improving agronomy and farm management practices.

The areas of Lise's research include:

- Disease management;
- Disease forecasting;
- Fungicide efficacy and resistance in cereals and other crops; and,
- Concentrating on the optimisation and minimisation of fungicide use in cereals and fungicide resistance.

"WA grain growers are seeing the first signs of fungicide resistance to chemicals used to control plant diseases," she said.

"Similarly to herbicide resistance, this can lead to rapid escalations in the cost of managing disease in grain crops.

"I will discuss my research and outline management strategies used by European farmers, who have already been dealing with fungicide resistance for a number of years.

"I will also offer suggestions about how the Australian grains industry and growers can manage fungicide resistance before it becomes a major problem."

The GRDC Grains Research Updates provide information on the latest innovations and research results and helps fine-tune growers' management strategies for the coming season.

For more information call GIWA on 08 6262 2128 or email researchupdates@giwa.org.au ■

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What's in Big Data for farmers?

DATA driven technologies have revolutionised all industries in which they've been adopted, and agriculture is no exception according to 2015 Nuffield Australia Scholar Jonathan Dyer.

For as long as he can remember, Jonathan from Kaniva in Victoria, has been highly intrigued by computers and digital technology, and how these can potentially enhance the grains industry.

Jonathan's Nuffield scholarship, supported by Rural Finance Corporation, investigated the possibilities 'Big Data' creates for improving farm practice and profitability and the impacts it will have on agriculture. His recently released report outlines the findings from his two year scholarship, which included travel to the US, England, Mexico, Brazil, NZ, Israel, Canada and France.

"I could see digital technology coming into farming in Australia, and I realised that very few farmers have the technology background that I do, having studied and worked in IT," Jonathan said.

Relatively cheap and easy

"We've been collecting various forms of data on our farm for more than a decade, but we've hardly been using it. 'Big Data' was starting to become a buzzword in the IT industry around the time that I had entered into agriculture and so I wondere –, what's in this for farmers?

"The rise of a myriad of cheap sensors, combining with more access to GPS technology has transformed on-farm data collection from an expensive and laborious process that few farmers could be bothered with, to one that is relatively cheap and increasingly easy.

"Once accurate data is being collected at the farm level, such data can be aggregated and compared across different businesses, regions, and countries. Farmers can use this aggregated data to analyse farm business performance. The promise of this is the potential for real-time business benchmarking."

Jonathan farms in a family partnership in the West Wimmera region, specialising in broadacre grain production on about 2200 hectares. The family grows a mixture of bread and durum wheat, canola, lentils, faba beans and chickpeas in a continuous cropping rotation.

As well as determining how farmers can best use and benefit from on-farm data collection, Jonathan's research analysed why third parties, for example agribusiness multinationals, are interested in gaining access to farmer's data, and what the potential implications are for farmers.

"There are many people who believe there is much value to be extracted from this data as evidenced by the venture capital flowing into new companies attempting to make use of it," he said.

"This may be concerning to farmers who may not understand the motivations behind a company wanting to access farmer data.

"But while these concerns about control of data are certainly valid, on the flipside more open supply chain data may allow for cheaper inputs and potentially even a new revenue stream for some farmers.

"It will certainly lead to better genetics and machines for farmers to use."

Key recommendations from Jonathan's report

- Using algorithms generated from farmer data for applying farm inputs such as fertiliser and seed hold much promise for improved farm management; and,
- Reliable and openly accessible soil and climate data underpin agricultural decision support systems.

Nuffield Australia provides opportunities to Australian primary producers and managers to travel the globe investigating a research topic important to them and Australian agriculture. Scholars are provided with a $30,000 bursary to embark on a 16-week program consisting of both group and individual travel over a two-year period. ■

Nuffield Scholar Jonathan Dyer from Kaniva, Victoria, was sponsored by Rural Finance.

Native eucalyptus oil shows huge promise for natural pest control

NSW Department of Primary Industries (DPI) scientists have taken the cue from a naturally occurring phenomenon to explore the potential of Australian eucalyptus to control major weeds and crop diseases.

DPI principal research scientist, Hanwen Wu, said research has identified eucalyptus essential oils which have the potential to address agrochemical resistance in these pests – one of the biggest challenges farmers face this decade.

"The allelopathic effect of eucalyptus trees – where chemicals they release suppress plant growth in the understorey – is commonly seen in the landscape and we applied a scientific approach to investigate that observation," Hanwen said.

"Laboratory tests showed that some eucalyptus oils, from a selection of 40 species, were able to completely suppress fungal growth of three major diseases – wheat yellow leaf spot and crown rot and canola sclerotina stem rot.

"We screened 300 eucalyptus species on weeds, including annual ryegrass, barley grass, fleabane, silverleaf nightshade and wild radish, to find that even at low concentrations some eucalyptus oils were able to prevent germination and growth of weed seeds."

Huge potential as a bioherbicide

Hanwen said there was huge potential to explore the use of eucalyptus essential oil as a bioherbicide for weed management.

"With rapidly growing herbicide resistance and no new molecules developed in the past 25 years which could offer new modes of action to control weeds, these naturally occurring oils could be a gift from nature," he said.

"We now need to find out how these oils work to inhibit weeds and diseases so we can adopt the technology for use in agricultural production and to safeguard the environment."

Further study of other eucalyptus species, followed by the identification of bioactive compounds, could provide chemical leads for the development of new herbicides with new modes of action.

An estimated 800 plus eucalyptus species in Australia offer a unique opportunity to manage weeds and crop diseases.

The research was funded by the NSW Government Weeds Action Program 2014–15, with support from Meat & Livestock Australia and the Graham Centre for Agricultural Innovation – an alliance between DPI and Charles Sturt University. ■

NSW DPI scientist Hanwen Wu says research showed that some eucalyptus oils were able to completely suppress fungal growth of three major broadacre crop diseases.

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Resource provides guidance on machinery investment

GRAIN growers' machinery operating costs in Western Australia – including the use of contractors – are on average, larger than their fertiliser and chemical costs combined.

Grains Research and Development Corporation (GRDC) Western Regional Grower Services manager Roger States said the average WA farming business had a 0.7:1 'machinery to income efficiency ratio'.

"This means that for every $100,000 of farm income (averaged over the past six years) they have $70,000 invested in machinery assets, at current market value," he said.

"The higher capital cost of machinery is offset by the efficiency gains of new technology and the reduced need for additional labour.

"But higher machinery investment costs have the potential to erode farm profits."

Roger said some of the factors to consider when deciding on the appropriate level of machinery investment included:

- Future changes to farming practices;
- Farm scale expansion;
- Labour skills and availability;
- Family and lifestyle needs; and,
- Competing investment and personal demands for capital.

He said information to guide WA growers on how much they could afford to invest in machinery was available in a new GRDC fact sheet – *Cost-effective Investment in Machinery* – available at https://grdc.com.au/InvestmentInMachinery.

"The fact sheet outlines how the most profitable farms tend to run, on average, a machinery to income efficiency ratio of about 0.7 to 0.8," Roger said.

"Those with the highest total debt levels tend to be greater than 1:1. Outsourcing some operations to contractors will generally move a farm business towards the lower end of the range.

"It should be noted that some farms and landscapes are less efficient for cropping operations yet can still be very profitable.

"An example is in highly undulating and broken country frequently found in higher rainfall zones."

Cost-effective investment in machinery is one of four WA-specific GRDC Farm Business fact sheets that have been recently released.

Others include:

- *Employing Seasonal Farm Labour for Western Australia's Grains Industry*;
- *Business Structures Explained*; and,
- *Business Structure: Things you should know and questions to ask your adviser.*

More information is available at https://grdc.com.au ■

GRDC Western Regional Grower Services manager Roger States says there are guidelines to follow when determining how much you can afford to invest in farm machinery.

Will low prices cure low prices?

By Peter McMeekin, Nidera Australia Origination Manager

ONE of the bigger talking points in mid January was the apparent reaction of US farmers to lower world wheat prices. According to the United States Department of Agriculture (USDA) winter wheat plantings have been slashed to their lowest level since 1909, and represent the second lowest planted area since records began.

In the USDA report the area sown to winter wheat was pegged at 13.10 million hectares – down around 10 per cent on the previous year. Analysts had anticipated a far more conservative reaction by the US farmer, expecting plantings to be around 13.82 million hectares.

The biggest change was seen in the Hard Red Winter (HRW) wheat area, which was down 12 per cent year-on-year. The largest declines were across the Great Plains, which spans the centre of the US from North Dakota and Montana in the north to Texas in the south. The Soft Red Winter (SRW) wheat seeded area was down only six per cent in comparison.

The CBOT futures market reacted by posting a moderate gain in March contract in the following trading session. But this is certainly not a game changer from a global perspective. It will undoubtedly tighten up the supply of US wheat over the coming season, but world supplies are still at record highs providing a buffer to the expected lower US production.

Additionally, the US decrease does not appear to have been replicated in other major production regions across the northern hemisphere. Early seeding forecasts suggest that the European Union (EU) grain growers have planted a similar area to cereals as last year and production is expected to increase in 2017–18, following the volume and quality issues that plagued the wet 2016 European harvest.

Russia estimating record harvest for 2017

In Russia, current estimates are putting the 2017 harvest at a record 117 million tonnes. In just 15 years, Russia has gone from a net importer of grains to one of the world's biggest exporters. The first reason for this is that the costs of production are significantly lower in Russia compared to many competing exporters, due mainly to the lower cost and abundance of arable land.

The second reason is Russia's proximity to Egypt and Turkey, two of the biggest wheat importers in the world. Most of the export grain is produced in the southern regions of Russia with a relatively short and inexpensive haul to the major Black Sea ports. The export drive is also being supported by Government construction of up country storage facilities and export capacity that will further enhance competitiveness into the export market.

The world has now produced record wheat crops four years in row. Grain growers across the globe are getting better at growing grain. The decrease in US plantings is not the catalyst we need to push prices higher. Sure it may put a floor under prices for the time being, but it will be major production issues in one or more of the key producers that will be required to drastically change the current low price regime.

Report issued January 17, 2017. ■

IGC sees a smaller 2017–18 wheat harvest

By Stephanie Bryant-Erdmann, US Wheat Associates

USDA will issue its first 2017–18 world wheat supply and demand estimates in May, but on January 19 the International Grains Council (IGC) provided an early look ahead at the next marketing year. IGC pegged 2017–18 world wheat production at 735 million tonnes (mt), down two per cent from the estimated 752 mt produced in 2016–17. If realised, it would still be the third largest wheat crop ever, but would be the first year over year decline in five years. For comparison, USDA estimates 2016–17 global wheat production at 753 mt.

IGC expects just two of the major exporting countries – Russia and Ukraine – to harvest more wheat in 2017–18, even though their estimates are up only one and two per cent, respectively.

IGC predicts European Union harvested area will remain stable in 2017–18. Harvested area is forecasted to fall three per cent in Argentina, Australia and Canada, while IGC expects farmers in the US and Kazakhstan to harvest eight per cent and 10 per cent less wheat, respectively.

Harvested area in Morocco is expected to rebound to a more normal level after widespread rain eased drought conditions that cut its 2016–17 harvested area by 26 per cent in 2016–17 to just 2.1 million hectares. Projected increases in India, North Africa, Turkey, Iran and Egypt will offset the expected decreases in harvested area among the major exporters according to IGC data.

2017–18 carry-in stocks are estimated at a record large 235 mt, up 6 per cent year over year, if realised. But the larger carry-in stocks are not anticipated to offset the forecasted decrease in production, and total world supply would decline 3 mt to a projected 970 mt.

For the first time since 2012–13, IGC expects total consumption to be greater than total production. Total consumption is forecast at 737 mt, down an estimated 1 mt from 2016–17. Food use will climb over 500 mt for the first time ever, partially offsetting an expected decrease in feed and residual use due to smaller production in Canada and the US.

IGC believes 2016–17 world wheat trade will shrink to 164 mt, down four per cent from the prior year, if realised. With consumption outpacing production, IGC expects carryout stocks to decrease marginally year over year to 234 mt. ■

What next after TPP?

By Douglas Lippoldt, Senior Trade Economist, HSBC Bank

AT A GLANCE...

- US withdrawal from the TPP will likely entail forgone economic gains in the 12 TPP partner countries, and possibly beyond.
- A US shift from a regional to a bilateral trade strategy may disrupt growth of production networks and be less efficient.
- The US and others could still draw on elements of the TPP to advance work on other trade deals.

The situation

On January 23, 2017, President Trump issued a memorandum with instructions for the US Trade Representative "to withdraw the US as a signatory to the Trans-Pacific Partnership (TPP), to permanently withdraw the US from TPP negotiations, and to begin pursuing, wherever possible, bilateral trade negotiations to promote American industry, protect American workers, and raise American wages." This executive action was undertaken unilaterally by the US President and did not require additional legislative steps.

The TPP was negotiated as an ambitious, high-standards, regional free trade agreement among 12 partners representing a diverse mix of economies – Australia, Brunei, Canada, Chile, Japan, Malaysia, Mexico, New Zealand, Peru, Singapore, the US, and Vietnam (Figure 1). It was structured to be open to new members, potentially including China. Although the US withdrawal was expected, it is still notable that the US had the lead in shaping the accord. Indeed, the TPP reflects key US priorities in liberalising trade in the region while addressing labour standards, the environment, and regulatory transparency, among other issues.

During the recent US election, many voters voiced their opposition to the TPP, often based on a perception that trade is the main factor driving job loss in industry. Yet, this is not supported by the evidence, which points to technological change as being the main culprit. Nonetheless, trade plays a role and may account for up to 25 per cent of the manufacturing job losses since 2000.

The economic literature points to the need for policies to support adjustment and provide an appropriate social safety net. Recourse to protectionism is not a remedy and is likely to damage the economy.

The implications

A 2016 study by the Peterson Institute for International Economics anticipated significant economic gains from the TPP, boosting GDP among the partners by some USD465 billion or more by 2030. The TPP is unlikely to survive in its current form, but the substance could accelerate development of other bilateral or regional agreements as a second-best option.

Accompanied by appropriate complementary policies, there are still gains to be had from further trade liberalisation.

Why pursue such a regional trade agreement?

In the decades since World War II, the US has played a leading role in the development of the rules-based multilateral trading system. With the establishment of the World Trade Organization in 1995 and further accessions to the WTO (perhaps most notably China, which joined in 2001), WTO membership came to cover most of the global economy. Development of a global framework for trade has some advantages over bilateral or regional accords. Instead of focusing on a limited set of trade relationships, a global approach has the potential to deliver broad and inclusive trade liberalisation, a unified basic rulebook for trade, and worldwide reductions in discrimination.

While the expanded membership at the WTO made a tremendous contribution to reduction of trade barriers and discriminatory practices, it also made it harder to reach accords for further liberalisation. The interests of the WTO membership are so diverse that it has not been possible to conclude a further global round of liberalisation since 1995. The WTO's Doha Round of negotiations, launched in 2001, subsequently stalled.

As a result, the US and other leading trading nations have increasingly pursued sectoral or plurilateral agreements at WTO. These are open to all WTO members wishing to opt in, but are limited in their scope. But, even here, progress has been slow.

Thus, outside the WTO, the US and other leading trading nations have pursued an expansive negotiating agenda for bilateral and regional accords. At this level, it has been easier for willing trade partners to pursue trade liberalisation efforts that are broader (ie. covering more issues like regulatory barriers, environment sustainability, and labour standards) and deeper (ie. with a greater depth of reductions in trade barriers).

But progress has been uneven. Hundreds of such agreements have been completed, yet many do not deliver deep effective liberalisation (eg. many do not adequately address non-tariff barriers such as red tape at the border).

The emergence of large numbers of bilateral accords also greatly increases the complexity of trade, with eligibility requirements (eg. rules of origin for products) and preference claim procedures that may vary by product and country. Where preference margins are thin or nontariff barriers are not

FIGURE 1: Membership of the Trans-Pacific Partnership

Source: HSBC Research, Trading Up: Trans-Pacific Partnership: The ratification hurdle, August 25, 2016.

adequately covered, businesses may forgo use of a free trade agreement altogether and simply ship under standard WTO most favoured nation terms (ie. the standard treatment available to any WTO member).

Regional trade agreements like the Trans-Pacific Partnership offer a good compromise between multilateral and bilateral accords. In cases where likeminded countries can come together to standardise and deeply liberalise their trade regimes, such accords can deliver significant results. The best regional accords permit producers to source inputs from the most competitive suppliers from across a region and to sell their finished products across the region.

This can deliver economies of scale in production, new opportunities to specialise, consolidation of markets for production that might not be feasible at the national level, and improvements in competitiveness through access to inputs that are of higher quality or lower cost, among other potential benefits. The European Union's single market and the North American Free Trade Agreement are two significant examples of regional accords that have delivered such results.

What did the TPP promise to deliver?

The Trans-Pacific Partnership is an unratified regional accord that would have offered tremendous scale, covering countries representing some 38 per cent of the global economy.

With a far-reaching liberalisation agenda, the agreement would have provided significantly improved market access in goods, services and trade-related investment. The accord would have permitted producers to source inputs and sell final goods across a large swath of the global economy. It would have gone beyond removal of traditional trade barriers like tariffs and quotas to address non-tariff barriers through improved regulatory co-operation and trade facilitation measures. It would also have closed gaps in the WTO provisions for the protection of intellectual property rights including notably, trade secrets.

The TPP would also have addressed many concerns expressed by critics of globalisation. It would have included environmental provisions to bolster the sustainability of trade (eg. by requiring ratification of CITES, the international treaty regulating trade in endangered species).

It would have required protection of internationally recognised labour standards and includes an enforceable action agenda for countries that have known shortfalls. The agreement also would have included provisions for the free flow of information. It defined more clearly the fair use of copyright protected materials, ensuring access for research and educational purposes. Moreover, at various points, it specified ongoing requirements for transparency and consultative mechanisms for stakeholders.

Reviving a zombie?

Is the US withdrawal a final blow for the TPP as now configured? It appears so.

In theory, the other 11 partners could proceed on their own once they duly amend the ratification requirements for the agreement (which anticipated US participation), but some partners have strong reservations to such an approach.

After an initial suggestion from Australia to proceed without the US, Japan made clear its initial opposition to the idea, calling such a limited TPP deal 'meaningless.'

One reason that such a scenario seems unlikely is that the TPP members were willing to make substantial commitments in the TPP on the assumption that it would afford them access to a regional market of tremendous scale. Without the US, the TPP regional

In its original form including the US, the TPP 'partnered' 12 countries representing 38 per cent of the global economy.

market is roughly 60 per cent smaller and under such changed conditions it is likely that the remaining TPP countries would find it difficult to justify some of their negotiating concessions.

At the same time, it may be that some of the innovative elements of TPP could be used in new or ongoing regional or bilateral negotiations.

Why is US withdrawal a problem?

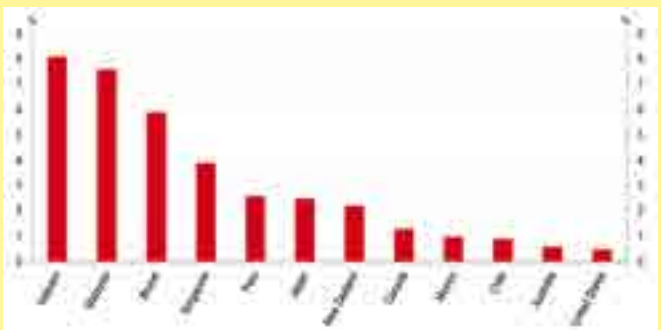
The economic damage from the cancellation of the TPP accord in its current form may not be immediately apparent. Much of the cost derives from forgone future gains in the region, translating into lower growth rates (Figure 2) and less innovation than would have otherwise been the case. These lost gains may not be obvious to some observers, but they are real. Slow growth in the TPP region could spill over into other regions through low TPP-country import demand. But a more immediate impact may be damage to the US' soft power and influence in the Pacific Basin region.

The TPP countries invested some 10 years in developing this accord and preparing for its implementation. The late US withdrawal undermines that country's credibility as a negotiating partner and damages the goodwill it had accrued in the development of an agreement offering a win-win outcome for the region. Moreover, negotiation of trade agreements is a resource intensive process, and its failure is costly not only in forgone gains, but also in opportunity costs.

Scarce negotiating capacity in some countries could have been otherwise deployed.

By shifting from a regional to a bilateral negotiating approach,

FIGURE 2: Estimated TPP national income effects, change from baseline, 2030



Note: These data are based on the central estimates provided in the PIIE paper.
Source: P A Petri and M G Plummer, The economic effects of the Trans-Pacific Partnership: New estimates (Peterson Institute for International Economics, January 2016).

the US may – given its scale – gain some negotiating clout. But, it may also decrease the ability of the US to influence the shaping of future trade rules for entire regions or globally. This could have negative consequences for the US. For example, in the event RCEP now advances to become the basic framework accord for trade across the Asia region, it cannot be guaranteed that the various elements in RCEP will align well with US interests.

The US withdrawal from TPP is also having a negative impact on business sentiment at a time the global economy can ill afford it. Moreover, from some news reports, it appears that the withdrawal may have emboldened advocates of protectionism in the US and potentially elsewhere – a development that could prove even more costly to the economy.

Although concerns about the US labour market have been raised as a justification for exiting the TPP, this action is unlikely to help address issues such as weak wage or employment performance in manufacturing. While import competition has led to adjustment costs and job loss in some areas, as noted above, most of the overall job loss in manufacturing is accounted for by technological change and related factors.

A healthier response from a social and economic perspective would be to better support the adjustment process though development of complementary policies to accompany trade liberalisation. For example, areas for action might include better equipping the labour force with skills and knowledge to adapt to change and to innovate. It could also include provision of an enhanced social safety net to provide income support during transitions and to assist in identification of new employment opportunities.

Other complementary policies may help to support the economy more broadly, such as investment in quality infrastructure and appropriate regulatory and tax regimes.

Unfortunately, the forgone growth potential associated with exit from TPP may leave the US economy worse off than it otherwise would have been. Moreover, in the absence of the high TPP standards, the regional market place may progress less rapidly in addressing some American concerns with respect to the environment, worker rights, protection of business confidential information, and transparency of regulation.

To sum up

Over the past 70 years, the US and its allies have broadly sought to shape the global economy through the promotion of open markets and free trade conducted under a rules-based framework.

This approach contributed to significant economic gains around the world and was a convincing proposition for many. It represented a view of the economy often made with reference to appealing values such as liberty and democracy. In terms of structure, it was built first of all upon a global foundation, supplemented by bilateral and regional accords like TPP.

While it cannot be ruled out that TPP members might eventually revive the agreement in an alternative configuration, this does not seem probable at this time. One is more likely to see the US shift to a more deal-based approach rather than appeals to values. This may diminish not only economic performance but also the buy-in and sustainability achieved under the previous global framework for trade.

Still, it is possible for trade liberalisation to advance under the new US strategic approach anchored in bilateral trade agreements. Accompanied by appropriate complementary policies for business and labour – and avoiding recourse to protectionist measures – such an approach can deliver economic gains.

Contact Douglas Lippoldt E: douglas.lippoldt@hsbc.com Ph: +44 20 7992 0375 ■

New policies generate some whiplash

■ **By Ben Conner, US Wheat Associates**

AS promised, on the first working day of his presidency, Donald J Trump fulfilled his campaign promise to withdraw from the Trans-Pacific Partnership (TPP), and gave notice to Mexico and Canada that the US intends to renegotiate some parts of the North American Free Trade Agreement (NAFTA).

For decades, US presidents of both parties have been largely consistent in their views on trade agreements. The TPP vision began under President George W Bush, and was almost fulfilled under President Obama – two presidents who agreed on few other policy areas. They both believed that opening borders to (mostly) free flow of trade in goods and services would benefit its TPP partners in the Asia-Pacific region and, in turn, US industries.

As producers of high quality wheat classes, US wheat farmers are oriented towards international markets. Through decades of experience, the industry also recognises that free trade agreements like TPP and NAFTA are good for our customers looking to expand their milling and wheat foods enterprises in part with US wheat quality and value. For exporters and importers, these agreements also offer rules to ensure that the resulting 'free trade' is also 'fair trade' or close to it.

It is clear that the Trump Administration does see some value in the existing trade agreements. Its next action on trade was to request a panel at the World Trade Organization (WTO) dispute settlement body in the US trade enforcement case about excessive Chinese subsidies. This request, made on January 25, starts the official litigation process under WTO rules.

One could be forgiven for experiencing a bit of trade policy 'whiplash.' On Day 1, President Trump withdrew from TPP alleging it is not strong enough for American workers – but then on Day 3 his Administration used WTO rules to act on behalf of American farmers.

The new trade enforcement rules under TPP would have been much stronger than WTO rules. Now that TPP is gone, the US must work within rather cumbersome WTO rules across most of the Asia-Pacific, at least until new trade deals are negotiated. ■

Proposed trade enforcement rules under the TPP – now abandoned by the US – would have been much stronger than existing WTO regulations.

Only 30 per cent of Australians are whole grain healthy

AT A GLANCE…

- Just 30 per cent of Australians are meeting the recommended three serves of whole grain a day, required for good health.
- Increasing whole grain consumption by just 1.5 serves may result in better health outcomes.

NEW global research on whole grains suggests that Australia is doing better than many countries for whole grain consumption, but it appears we still have a long way to go to meet the amount of whole grain needed for good health. Three serves of whole grain a day are recommended for a lower risk of chronic disease and better health outcomes, but in Australia, just one in three people meets this target.

While Australia is doing much better than the UK – where just 17 per cent of people meet targets and the US where only eight per cent eat enough whole grain – we're still not doing nearly as well as countries like Denmark, Sweden and Norway.

Residents in these countries typically consume twice as much whole grain as the average Australian and are likely to experience fewer instances of chronic disease as a result.

But although 70 per cent of Australians are falling short of the whole grain recommendation, there are plenty of opportunities to choose whole grain foods more often and increase your whole grain intake. In fact, the average Australian only needs an increase of just 1.5 serves of whole grain a day to meet the recommended three serves and reap the significant health benefits of higher whole grain intake.

And this could be as simple as swapping the white bread in your sandwich for a wholemeal variety, or switching a serve of white rice with your dinner for brown rice.

Choosing whole grain foods is important as it increases your intake of fibre and essential nutrients, as well as reducing risk of diabetes and heart disease by 20–30 per cent. Two out of three Australians would benefit from changing their habits by making at least half their grain food choices whole grain and looking for foods higher in whole grain.

With increasing innovation in the whole grain category, it's easier than ever to choose foods higher in whole grain, but industry faces a significant challenge for communication of whole grain content, both on pack and in product marketing, due to a lack of regulation on whole grain content claims.

Currently, the Australian New Zealand Food Standards Code doesn't regulate the use of whole grain content claims on different foods. So products making whole grain claims can contain differing amounts of whole grain – some breads for example may vary from 6 grams of whole grain per serve right up to 60 grams per serve.

So how do we eliminate the confusion?

To ensure consumers are receiving consistent information on whole grain content, the Grains & Legumes Nutrition Council (GLNC) launched the Code of Practice for Whole Grain Ingredient Content Claims (the Code) back in 2013. The Code sets guidance for the minimum amount of whole grain a food must contain in order to make a whole grain content claim on pack, such as 'contains whole grain', 'high in whole grain' or 'very high in whole grain'.

As such, when a product carries one of these claims, consumers can rest assured that they're getting enough whole grain to make a positive impact on their health.

Rebecca Williams, Nutrition and Code Manager of the Grains & Legumes Nutrition Council says "In a recent assessment of whole grain foods on shelf we found most breakfast cereals labelled as whole grain were in fact very high in whole grain. So people can be confident they are making a good choice."

Since its launch in 2013, over 100,000 tonnes of additional whole grain have been added into the food supply as a result of the Code. This is the equivalent of over 400 Olympic sized swimming pools – a fantastic result for consumers which presents a real opportunity for higher whole grain consumption and better health outcomes within Australia.

Grains & Legumes Nutrition www.glnc.org.au ■

Post-harvest ideal time for stored grain fumigation

WITHIN three weeks of the completion of harvest is the best time for a grower to fumigate stored grain to control insect pests, according to grain storage expert Ben White.

Ben is a Western Australia-based member of the Grains Research and Development Corporation (GRDC) grain storage extension team.

He said grain was warm at this time of the year and insect activity was high in warm conditions so fumigants would work rapidly and effectively.

Ben said a clean start was a good start in preventing insect damage and preserving grain quality and growers ideally should have washed silos and applied structural treatments, such as diatomaceous earth (DE), prior to silos being filled with grain.

"All grain and grain dust residue should be removed from the storage site, including from grain hoppers and any steel silo support structures, and weeds around the storage site should be removed," he said.

When applying phosphine, make sure the tablets are no more than two deep in the tray or phosphine ground applicator. (PHOTO: GRDC grain storage extension specialist Chris Warrick)

Pressure tested sealable silo is essential

Ben said fumigation should only be carried out in a pressure-tested sealable silo.

"Fumigation in silos with leaks may appear successful when some dead adults are found, but many of the eggs, pupae and larvae are likely to survive and will continue to develop and reinfest the grain," he said.

"These partial kills are often worse than no kill at all because the surviving insects are likely to be those that carry increased phosphine resistance genes.

"Under-dosing risks increasing the number of insect populations carrying the genes for phosphine resistance and this has serious consequences for the industry."

Phosphine is the most commonly used fumigant to control stored grain pests in Australia but other options include nitrogen and carbon dioxide.

"Each of the alternatives to phosphine still requires a gas-tight, sealable silo and are currently more expensive than using phosphine, but offer an alternative for resistant pest species," Ben said.

Ben said if aeration cooling fans were fitted to grain storage silos, growers could operate these again after a fumigation period of seven to 10 days.

If growers are unsure about how to correctly fumigate grain or have questions about any aspect of stored grain procedures, they can call their local GRDC grain storage extension specialist on 1800 WEEVIL (1800 933 845).

Information is also available at http://www.storedgrain.com.au

To support growers with their on-farm grain storage preparations, the GRDC has released a Stored Grain app for iPhones and iPads. It can be downloaded for free from the iTunes store, or via https://grdc.com.au/Resources/Apps ■

Grain protectants build barrier against storage pests

GROWERS planning to store grain in unsealed storages after this year's harvest are being encouraged to consider using grain protectants to reduce the risk of insect pest infestations.

The use of protectants combined with meticulous hygiene and aeration cooling are especially useful in storages which are not gas-tight and therefore cannot be fumigated effectively.

Queensland Department of Agriculture and Fisheries (DAF) researcher Greg Daglish warns that protectants are designed to prevent pest infestations, not to control an existing problem.

"It's a common misunderstanding, but research shows us that grain protectants work best to protect grain where there is no pest infestation. There is no guarantee a protectant will kill existing pests," Greg said.

"To give your protectant its best chance of working, grain should be clean and pest free and the product should be applied quickly after harvest when this is most likely. The longer grain is stored the more chance that you will have a pest problem.

"Like all aspects of grain storage, the decision to use a protectant must be researched, planned and implemented to a specific timeframe."

Know your registered uses and markets

This point is particularly important in reference to markets, with Greg saying growers need to know whether or not protectant treated grain will be accepted at sale.

"Generally speaking protectants are only registered for use on cereal grains and of those only some protectant products are registered for use on malting barley, rice and maize. No protectants are registered for use on pulses and oilseeds.

"Growers need to have a buyer secured, and know what that buyer will or won't accept as part of their planning process."

He says there are few options available to growers to control storage pests when an infestation is detected.

QDAF researcher Greg Daglish cautions that growers need to know their grain buyers' requirements in terms of treated stored grain.

Protectants prevent pest infestations – they don't control an existing problem.

"Phosphine, sold in the solid formulation of aluminum phosphide (AIP) – under trade names such as phostoxin and fumitoxin – is by far the most common disinfestation treatment for stored grain," he said.

"But the label was first written in the 1970s for relatively small silos and other storages. Now a significant number of growers have invested in large capacity (1500 tonne) flat bottom silos, so trials were needed to see if current label rates would work in these larger storages.

"It is also incredibly important that growers have a silo that is sealable to the Australian standard, or fumigation simply won't work."

Another option for reducing the likelihood of grain pests is aerating stored grain from when it goes into storage.

"Cooling grain below 20°C dramatically reduces grain insect population growth. Experience shows that to get the best results, the aeration fans should be turned on from when you first start loading the bin.

"This allows the aeration system to exploit the evaporative cooling effect of any moisture that may be in the freshly harvested grain.

"Where grain is already dry, it is still valuable to utilise cooling aeration as it removes the 'harvest heat' from grain that is often 30° to 35°C going into the silo, due to the daytime temperatures during wheat and barley harvest."

Some protectants start deteriorating 48 hours after being mixed with water so growers should avoid leaving prepared protectants for long periods before applying to grain. The product label will also indicate the anticipated effective life of the protectant on the grain.

The effective life of protectants may be shortened if applied to grain above 12 per cent moisture content and at temperatures above 27°C, or if treated grain is exposed to direct sunlight which can occur at the end of a shed or in an open bunker.

Further information on grain protectants is available from the GRDC's Stored Grain Information Hub at http://www.storedgrain.com.au or phone 1800 933 845. ■

New canola releases for 2017

Compiled by Don McCaffery Technical Specialist (Pulses and Oilseeds), NSW DPI

At least eight new canola varieties will be on the market for 2017, making a total of 58 varieties from which growers can choose.

Sowing date and seasonal conditions have a marked effect on early vigour, accumulation of biomass, start of flowering and maturity of different canola varieties.

Maturity statements about varieties included here relate to physiological maturity, when the crop is ready for windrowing, and have been provided by the seed companies. Blackleg ratings are drawn from the GRDC *Blackleg Management Guide* Factsheet. The NSW DPI Winter Crop Variety Sowing Guide 2017 will be published in April, providing the latest crop performance data from the National Variety Trials.

Triazine tolerant (TT) varieties

InVigor T 4510 (coded PJTT3): Early–mid maturing hybrid. Medium plant height, suited to medium rainfall areas. No published GRDC blackleg rating or resistance group 2016. Tested in NVT trials for the first time in 2016. Marketed by Bayer.

Pioneer 44T02 (TT) (coded PHT-1504): Early-mid maturing hybrid. Medium plant height with strong early vigour. Suited to medium–low rainfall zones. Blackleg rating spring 2016 R–MR and resistance group ABD. Tested in NVT trials 2015 and 2016. Marketed by Pioneer Brand Seeds.

SFR65-013TT: Mid maturing hybrid. Moderate height. Suited to medium–high rainfall zones. No published GRDC blackleg rating or resistance group 2016. Tested in NVT trials for the first time in 2016. Bred by NPZ Australia. Marketed by Seed Force.

SF Ignite TT (coded SFR65-014TT): Mid maturing hybrid. Moderate height. Suited to medium–high rainfall zones. No published GRDC blackleg rating or resistance group 2016. Tested in NVT trials for the first time in 2016. Bred by NPZ Australia. Marketed by Seed Force.

Clearfield (imidazolinone tolerant) varieties

Pioneer 44Y90 (CL) (coded PHI-1502 in 2015): Early–mid maturing hybrid, longer maturity compared with 44Y89 (CL): Medium plant height. Suited to high–low rainfall areas, Blackleg rating spring 2016 R–MR and resistance group B. Tested in NVT trials in 2015 and 2016. Marketed by Pioneer Brand Seeds.

Pioneer 45Y91 (CL) (coded PHI-1402 in 2014): Mid maturing hybrid. Medium–tall plant height. Blackleg rating spring 2016 R–MR and resistance group B. Tested in NVT trials 2014 and 2016. Marketed by Pioneer Brand Seeds.

Roundup Ready varieties

InVigor R 5520P (coded AN14R9012): Mid maturing hybrid with Bayer's pod shatter tolerance trait PodGuard. Suited to later windrow timings or direct harvesting in medium–high rainfall areas. Blackleg rating spring 2016 R–MR and resistance group AC. Tested in NVT trials in 2015 and 2016. Bred and marketed by Bayer.

Nuseed GT-53 (coded NCH13G046): Mid maturing hybrid. Medium–tall plant height. Suited to medium–high rainfall zones. Blackleg rating spring 2016 R and resistance group unknown. Tested in NVT trials 2014 (2 trials), 2015 and 2016. Bred and marketed by Nuseed Pty Ltd.

The following varieties are outclassed but seed will still be available for 2017

- ATR-Gem
- Hyola 50
- Hyola 474CL
- Hyola 577CL
- Monola 314TT
- Monola 513GT
- Nuseed GT-41
- SF Sensation

The following varieties have been withdrawn for 2017

- AV-Zircon
- IH52RR
- Pioneer 43C80
- Pioneer 45Y86 (CL)
- Pioneer 45Y88 (CL)
- Pioneer Sturt TT
- Rimfire CL
- Victory V5002

More information: GRDC *Blackleg Management Guide*

Acknowledgments: Canola Seed Companies; Leigh Jenkins, Research and Development Agronomist, NSW DPI; Rohan Brill, Research and Development Agronomist, NSW DPI.

Australian Oilseeds Federation: www.australianoilseeds.com ■

AHRI **insight...**

New boy band – 'The Feathertop Rhodes'

Feathertop Rhodes (FTR) Grass is the boy band of the weeds world. They pop up quickly from obscurity (first to germinate after rain), stress easily at the first sign of trouble (dry), and can be all done and dusted in 18 months (short seed life), not to mention that they are downright annoying as well!

If you think this is just a Queensland problem, think again.

This boy band – I mean weed – has risen to fame in recent years as it has spread from its home in Queensland to playing gigs on road verges all over the country.

When faced with an enemy we need to quickly understand its biology so we can exploit its weaknesses. The weakness of FTR appears to be its seed. It is small and short lived – like One Direction!

IN this edition of AHRI Insight, we review the biology of FTR as studied by numerous scientists and compiled in a review by Darren Aisthorpe from Queensland Department of Agriculture and Fisheries (DAF QLD).

May we one day celebrate the demise of all boy bands and Feathertop Rhodes Grass, and may we never see a boy band called 'The Feathertop Rhodes'!

Many researchers have contributed to understanding FTR over the years and it is now that we can benefit from this research. Let us consider some of the key elements.

Identification

Firstly, if you are from the southern half of Australia and haven't seen this weed you might want to get to know it so you can do something about it when it turns up (see photo below).

Small seed = shallow germination

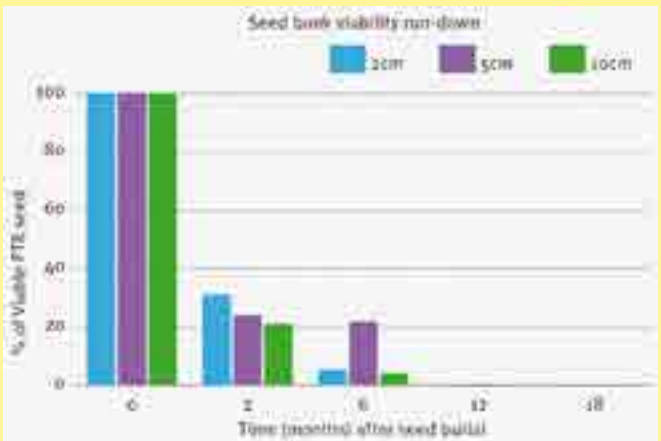
FTR seed is small, meaning that it won't germinate from depth. The vast majority of seed will germinate from the 0–2 cm soil layer. The zero till system in the north has played right into its hands. While tillage is not popular for many growers, it can be effective. Many growers in Central Queensland have reverted to using strategic tillage, and many are finding it works well when used in combination with a pre-emergent herbicide applied prior to the next rainfall event.

Short lived seed

Research by Vikki Osten (while working for DAF QLD) in Emerald shows that the vast majority of FTR seed survives for less than 12 months regardless of the depth of burial (Figure 1). In practice, many growers and agronomists have observed that 18-month seed life is typical in the field.

Regardless of whether it is 12 or 18 months, it's good news. If we put our mind to it and stop seed set for 18 months to two years we can get on top of a problem quickly.

FIGURE 1: The decline in seed viability of FTR over time at three different burial depths



(Source: DAFF Qld)

Feathertop Rhodes Grass has moved southwards from its Queensland home.

Natural tolerance to glyphosate

FTR is extremely hard to kill with glyphosate at the best of times and if the plant gets stressed or too big it becomes nearly impossible to kill. Figure 2 shows exceedingly poor control of even small plants with two litres per hectare of Roundup PowerMAX. There are now resistant populations that will be a whole lot harder to kill than those represented in Fidure 2. This is the true challenge of FTR as there is no preferred/reliable knockdown strategy for this weed.

Many are using group A (Fop) herbicides in the knockdown mix, but resistance is a real threat with this group of products – so perhaps these herbicides should be saved for in-crop use. A second knock is a legal requirement if using Group A products in a fallow situation and strongly recommended for any other knockdown applications. Paraquat on very small grass can be effective, but it needs to be small and spray application must be excellent to hit the target. Reverting to tillage may be useful strategically but there are many issues that will arise if it is over-used. There's no simple solution here, hence the emphasis on the necessity to target the seed bank.

FIGURE 2: Average efficiency of 2 L/ha of Roundup PowerMAX on various FTR growth stages across Central Queensland

(Source: CQ Grower Solutions)

Shallow roots

It's a very showy plant, and whilst it looks bulky above ground, it's only supported by a minimal and shallow root system. Strategic shallow cultivation can be extremely effective in dryer seasons and as mentioned earlier, combines well with pre-emergent herbicides applied after tillage and before the next rain.

Easily stressed

The plant stresses quickly when conditions get dry and often shows stress symptoms before other weeds.

Quick to set seed

One of its more undesirable characteristics is its capability for producing viable seed at six weeks after germination in the right conditions. While we may only need to hammer it for a year or so to get on top of the seed bank, we may need to control it several times in that year.

To sum up

There's a whole lot more to controlling Feathertop Rhodes Grass than is mentioned above, but if we begin to understand the biology of this weed, we can work towards a robust plan that includes herbicide and non-herbicide tools. Unfortunately, FTR is not going to be a flash in the pan boy band. We're probably stuck with it, but we can manage it if we understand the biology and make a plan that exploits its weaknesses. As with many other resistant weeds, it's all about the seed bank! ■

About weed seeds and their longevity

■ By the Weed Science Society of America

WEEDS can be prolific seed producers, which means if a single plant is allowed to go to seed, its impact may be felt for many years to come. One example: the broadleaf weed *Palmer amaranth* has been found to produce as many as a million seeds per plant.

To compound the problem, the seeds produced by many weed species can remain dormant – hidden away in the soil for extended periods of time – and then sprout when conditions are right. While seeds of most annual weedy grasses die after two or three years, scientists have discovered that some broadleaf weed seeds can remain viable for many decades.

Scientific proof of longevity

One of the most famous experiments illustrating the longevity of weed seeds dates back to 1879. Professor William Beal at Michigan Agricultural College set out to determine how long seeds could be buried in the soil and still remain able to germinate.

Beal started with freshly grown seeds from more than 20 common weed species and buried them in 20 sand-filled bottles about three feet below the soil surface. At five- to 10-year intervals throughout his career, he would dig up a bottle to see if the seeds it held would germinate. Many did.

When Beal retired, he passed the torch to fellow scientists

Moth mullein germinated from seeds buried in 1879 and excavated in 2000. (Courtesy of Frank Telewski, PhD, professor and curator, W.J. Beal Botanical Garden, Michigan State University)

at what now is Michigan State University. They've continued Beal's research, and what they've found is bad news for farmers and home gardeners alike. More than 130 years after Beal's experiment began, some of the seeds he planted are still able to germinate. The heartiest has been moth mullein, a flowering biennial weed from the figwort family.

Why some weed seeds are long-lived and others aren't

While some weed seeds will survive for long periods, many others will die within a few days or weeks if they aren't in an environment suitable for germination. Why the difference?

Seed coats are an important factor. The hardest coats

DISPELLING COMMON MISCONCEPTIONS ABOUT 'SUPERWEEDS'

Use of the term 'superweed' has exploded in recent years and is frequently featured in news reports about herbicide-resistant weeds choking out crops.

While there is no science-based definition for superweed, the term is often used to describe weeds believed to have special capabilities that are helping them outcompete other plants in ways never experienced before. Many associate superweed with glyphosate-tolerant crops and the suspected transfer of resistance genes from these crops to weeds. The Oxford Dictionary, for example, is one of many online resources to define superweed as "a weed which is extremely resistant to herbicides, especially one created by the transfer of genes from genetically modified crops into wild plants."

But is that the truth? Are today's weeds 'supercharged' in some way? And if so, why is that the case?

As a nonprofit organisation that promotes science-based information about weeds, their impact on the environment and how they can be managed, the Weed Science Society of America (WSSA) has compiled the information below to clarify two common misconceptions about superweeds.

Misconception 1

Rampant gene transfer between genetically modified crops and weeds is creating weeds able to resist treatment by herbicides.

Reality: There is no evidence that gene transfer is a major factor in the development of herbicide resistance. Instead, overreliance on herbicides with a single mechanism of action to control certain weeds has led to the selection of weeds resistant to that mechanism of action.

The transfer of resistance traits from genetically modified crops to weeds growing in the field is rare, and the occurrences observed and reported to date have had minimal impact.

The only currently known mechanism for any crop trait to move into weeds (or vice versa) is through cross pollination – a sexual crossing between the crop and the weed. Gene flow is more likely to happen if the crop and weed are sexually compatible, near relatives.

Gene flow among more distantly related plant species is rare because they do not cross as readily. There are often physiological barriers, including pollen incompatibility, varying numbers of chromosomes and other factors that serve as impediments.

Even among sexually compatible crops and weeds, the opportunity for crop-weed gene flow depends on proximity of the crop plant to its wild weedy relatives. For example, there have been no reports of gene transfer in the more than 160 million annually planted acres of genetically modified corn, cotton and soybean crops in North America where herbicide resistance weeds are such a significant issue today.

Since these crops don't have sexually compatible, near relatives in the US and Canada, the risk of gene flow to other plants in the region is extremely low.

Crops like sunflower, wheat and canola do have compatible weed relatives in their major production areas (eg. wild

Sunflower, wheat and canola crops have compatible weed relatives in their major production areas.

sunflower, jointed goatgrass, and wild relatives of canola, respectively). As a result, the risk of gene flow between those crops and wild plants is greater. Where gene flow has occurred, the resulting plants are no more weedy than their parent plants.

Misconception 2

Herbicide use is creating a new breed of herbicide-resistant superweeds unlike anything we've ever seen before.

Reality: The costly issue of herbicide resistance isn't new – and neither are the competitive characteristics of weeds. Although the number of acres affected by resistant weeds has increased over the last decade as more growers have come to rely solely on herbicides with a single mechanism of action for weed control, weeds have exhibited resistance to many types of herbicides over the past 40 years.

Many weed populations have even evolved resistance to multiple herbicide mechanisms of action.

Herbicide resistance is an important, costly and escalating issue, especially as growers have come to rely more than ever on a single class of herbicides that targets weeds in the same way.

It is more critical than ever for a variety of carefully integrated weed management strategies to be used so weeds resistant to one method can be controlled in other ways before they have an opportunity to spread. This includes nonchemical means of weed control, such as crop rotation, tillage, cultivation, hand hoeing, seed capture, and so on.

As to those super powers that many individuals ascribe to herbicide-resistant weeds? Under herbicide-free conditions, resistant weeds are no more competitive or ecologically fit than their susceptible partners.

Note:
The WSSA thanks the following scientists for their special contributions to this document:
Brad Hanson, Ph.D., Cooperative Extension Weed Specialist in the Department of Plant Sciences at the University of California - Davis.
Andrew Kniss, Ph.D., Associate Professor in the Department of Plant Sciences at the University of Wyoming and a WSSA board member.

Fruit of the Venice mallow weed can house 3000 or more small hard-shelled seeds.
(Photo courtesy of Greta Gramig, North Dakota State University)

provide the best protective barrier and promote longevity. These tough coats may also help to keep the seed hidden from predators by keeping it from giving off any odours that might be detected. Burial in the soil also enhances seed survival by inhibiting germination and protecting seeds from predators and environmental stresses.

Interestingly, scientists have discovered some weed species produce seeds that vary widely in size and dormancy periods. Examples include poison hemlock, jointed goat grass, twoscale saltbush and common cocklebur.

By staggering germination throughout the growing season, the likelihood is greater that at least some plants will emerge to favourable conditions, enhancing overall survival.

What causes seeds to germinate – or keeps them from doing so?

A number of factors can trigger weed seed germination, including changes in temperature, moisture, oxygen and light.

Wild oat seeds have prominent hairs that bend and straighten in response to moisture and can bury freshly scattered seed in soil. Above, two seeds are intertwined.
(Photo courtesy of Eric Johnson, University of Saskatchewan)

Tillage is an especially common trigger. It exposes buried seeds to warming sunlight and aerates the soil.

There also are factors that can inhibit germination. The soil is a factor – especially for smaller seeds. It serves to block the light signals the seeds need in order to determine they are close enough to the surface to germinate. Some small seeds can't emerge if they are more than 5 cm underground.

The same seed coat that protects seeds from destruction can also inhibit germination. These hard barriers can prevent the seed from getting the moisture or oxygen needed to germinate and can forcibly enclose the embryo. Physically scratching the seed coat to weaken it makes germination more likely.

Another factor that can impact germination is allelopathy – a biological phenomenon that involves one organism producing biochemicals that positively or negatively influence the growth, survival and reproduction of other organisms. For example, crops like rye, sorghum, rice and wheat release biochemicals that can suppress weed seed germination.

How weed seeds travel

Weed seeds can be spread in feed grain, straw and hay and can be transported by birds, animals, water and wind. But they can also travel in other less expected ways. Seeds can stow away on farm machinery, off-road vehicles and cars. They can hitch a ride with container-grown ornamentals or travel the country in a package of wild bird feed. Seeds with burr-like surfaces can travel attached to your clothes or to animal fur.

Earthworms are known to collect weed seeds and move them into their burrows. In fact, scientists say more than two-thirds of all giant ragweed seedlings emerge from earthworm burrows.

Seeds consumed by livestock can often survive and can be transported in manure.

The award for longest-traveling weed seeds would likely go to horseweed. Tiny horseweed seeds have tufts that act like a parachute and help them travel vast distances by air. Specially equipped model airplanes have discovered horseweed seeds in the earth's planetary boundary.

To learn more about weeds visit www.wssa.net ■

Tiny Canada thistle seeds have feathery tufts that help them disperse by air.
(Photo courtesy of Erin E. Burns, Ph.D. student at Montana State University)

Mobile system removes phosphorus from manure

By Jan Suszkiw, Agricultural Research Service – USDA

AT A GLANCE

- Using too much manure can lead to nutrient runoff.
- ARS's mobile system extracts nearly all phosphorus from manure.
- The resulting solids are easier for farmers to manage.

A MOBILE system for removing phosphorus from cow manure developed in the US may offer dairy farmers and lot feeders greater flexibility in where, when, and how the nutrient can be used to fertilise crops.

Manure can be spread onto crop fields as a source of phosphorus, nitrogen, and other nutrients important to plant growth. But applying too much manure can lead to excess phosphorus that ends up in lakes, rivers, ponds, and other water sources, degrading their quality.

The idea behind the Manure Phosphorus Extraction System (MAPHEX) is to remove the phosphorus and concentrate it in a form that's easier to manage, says Clinton Church, an Agricultural Research Service (ARS) environmental chemist at University Park, Pennsylvania – a state that boasts 531,000 milking cows and ranks fifth in the US in dairy production.

Hauling manure off the farm to new field locations where it can be spread isn't always feasible. For example, "Some farmers with plenty of land may need to drive 20 miles or more to reach some fields. That makes transporting large volumes of manure uneconomical (or impractical), even if the crops there need phosphorus," notes Clinton.

Transporting concentrated phosphorus from the new treatment method would be far less costly.

Working with Pennsylvania State University collaborators, Clinton and his ARS colleagues developed and tested MAPHEX as a way farmers could not only 'mine' phosphorus from their manure stores, but also market the nutrient as a value-added product.

How the unit works

To do this, the team mounted an auger press, centrifuge, vacuum-filter unit, and other components atop two trailer beds so that the entire system could be driven to a farm and operated on-site, either on a daily or rotational basis depending on the size of the operation.

"In Pennsylvania, there are a lot of small dairy farms with 100 to 150 cows," says Clinton. "We made the system mobile so that we could service 10 small farms on a 10-day rotational basis."

On a larger farm, like one with 2000 cows, the system could operate over 24 hours, he adds.

MAPHEX works in three stages, each removing progressively smaller fibre particles and other phosphorus-containing solid matter from the manure. In addition, there is a chemical treatment step between the last two stages to convert dissolved phosphorus into a filterable particle.

Water extracted from the manure is retained on the farm; it contains most of the manure's nitrogen, making it ideal for fertigation.

USDA researchers have developed a mobile system that concentrates phosphorus from dairy cow manure.
(PHOTO: Rada Hristov)

MAPHEX works quickly. In about 10 minutes, for example, it can extract 99 per cent of the phosphorus from 250 gallons (950 litres) of manure. Additionally, "it removes the odour from the manure, which is a big deal if that manure will be spread next to a town," adds Clinton.

The fibre and other phosphorus-containing particles exit the system as concentrated solids, which can then be transported for use on off-farm crop fields or sold to nurseries and other outlets as a plant and soil amendment.

Solids from MAPHEX's first treatment stage could also be sold as cow bedding material, offering a lower phosphorus content and a lower risk of the nutrient's environmental escape than the manure solids-based bedding now used.

Other possible uses include material for creating biodegradable pots, whereby traces of the nutrient can help feed and sustain the plants seeded into them.

The MAPHEX team will begin demonstrating a full-scale version of its patent-pending system on a working dairy farm in the 2017 northern hemisphere spring and welcomes inquiries on its commercial potential.

More information: Clinton Church, Pasture Systems & Watershed Management Research Chemistry – USDA.
Email: Clinton.Church@ars.usda.gov – Ph: +1 814 863 8760

Farming in Foreign Fields...

Changing the face of farming in Romania

Marian Budu has been the driving force behind farm expansion from 110 hectares to 2100 hectares today.

AT A GLANCE...

- Agriculture in Romania has advanced rapidly during the past two decades.
- Today, it is at the forefront of global farming in terms of the scale of the enterprises, the machinery which is used and how that is put to work.

FARMING practices in Romania have experienced massive change since the turn of the century, driven by progressive agri-businesses such as SC Euromar 95 SRL. The company, which is based at Lanurile in Constanta, a picturesque region east of the country's capital Bucharest and bordering the Black Sea, is reaping the rewards of its investment in the latest technologies.

In this major grain producing area – the 'breadbasket' of Romania – a new generation of farmer-businesspeople is taking a very critical look at what has to be done to produce better crops.

For too long, farms in this region used the wrong tools to establish crops, which resulted in a very hard, yield-limiting plough pan being formed 30 to 35 cm under the surface of the soil.

The only way to put that right is to use equipment which can break through this compacted layer, which is why forward-thinking farmers are harnessing the latest techniques and powerful machinery.

Marian Budu represents the changing the face of agriculture in Romania. Extremely modern and open-minded in his approach, he has transformed what was traditionally-farmed land into a highly-productive farming business. Large by the standards of the region, the company employs 11 staff.

Having joined SC Euromar 95 SRL 18 years ago, Marian has been the driving force behind its dramatic expansion, from 110 hectares of flat land then to 2100 hectares today.

FARM FACTS...

Location: Constanta, Romania (Black Sea region).

Size: 2100 hectares.

Average field size: 40 hectares.

Climate: Average of 250 mm rainfall per annum with strong winds and high summer temperatures.

Crops	Area (ha)	Average yield (t/ha)
Sunflowers	510	3.5
Wheat	500	7.0
Maize	400	8.0
Oilseed Rape	340	3.6
Barley	250	7.3
Soybeans	100	2.0

Although the chernozem type soil (dark with high humus percentage) is potentially very productive, the business has to contend with low annual rainfall – just 250 mm – strong winds and high summer temperatures, although there are no particular agronomic issues in terms of weeds or diseases.

Yields up 40 per cent

Previously, traditional crop establishment practices involved ploughing, followed by two passes with disc harrows, then drilling. Now, having adopted the latest Case IH equipment, yields have increased by 40 per cent.

To improve timeliness of establishment, the company has replaced the 15 small, two-wheel-drive Romanian-built Universal (UTB) tractors – which were very basic, lacked power and offered no comforts for the operator – with the latest Case IH equipment.

This process began in 1998 when Marian became manager and he purchased the farm's first Case IH product – an MXM 190 tractor. Today, the business operates a wide range of Case IH models. The current fleet includes JX 95, Maxxum 140, Magnum 310 and Magnum 335 wheeled tractors, a Steiger Quadtrac 600, an Axial-Flow 2388 combine together with two key pieces of Case IH tillage equipment.

The Steiger Quadtrac, which has become popular with large farming businesses in the region, was purchased to ensure that cultivation work could be carried out more quickly after harvest, improve the timeliness of sowing crops and reduce compaction, all with less labour.

"It is a very nice machine – very impressive," Marian explains. "Compared with models from other manufacturers it is simple to operate, offers maximum traction, is very reliable, highly efficient and works on all soil types. We love it.

"Our farming operations now revolve around the Quadtrac 600, which is equipped with the Case IH Advanced Farming System (AFS) and full RTK GPS, which is accurate to 2.5 cm," Marian points out. "The tractor produces up to 669 horsepower and does the hardest work which requires the most power."

New method of crop establishment

The Quadtrac pulls a 6.7 metre-wide Case IH Ecolo-Tiger 875 disk ripper at an operating depth of 30 cm and a forward speed of 10 km per hour, covering 65 hectares in a 10-hour day. The tractor is also used with 13 metre-wide Case IH True-Tandem disc harrows for spring cultivations, operating 25 cm deep at 12 km per hour and covering 168 hectares in the same time.

For drilling, the farm uses a 7.2 metre Horsch Focus with an output of 8 hectares per hour.

"For me this new method of establishing crops is the best," Marian states. "It has reduced our production costs, improved the timeliness of establishment and put right years of damage to the soil caused by ploughing. This has enabled us to produce much higher yields from all our crops.

"Following generations will rely heavily on this type of technology and produce higher yields than us. Case IH will be there to help them do that." ■

AGRONOMIC DESIGN FOCUS AIDS SOIL HEALTH

Held across eastern Europe during 2016, Case IH 'Agronomic Design' workshops have been attended by key customers in the region, with owners and operators able to find out first-hand how the latest technology can help protect soils.

The events focused on soil compaction cost and reduction. "The workshops included a soil pit dug into the host field to illustrate the creation of a plough pan," explains Christof Feuerhake, Operational Marketing East Europe and Balkans.

"This showed clearly the compaction effects of tyres travelling in the furrow when ploughing. Years of ploughing at the same depth creates a compaction layer – a plough pan – at 25–30 cm between the top and sub-soil. But shallow soil cultivations – typical of minimum tillage practices, such as discing – also create shallower compaction at 8–10 cm, right under the seedbed horizon, leading crops to produce 'lazy', shallow roots."

"A well-structured soil absorbs water more rapidly to reduce the likelihood of flooding and erosion. Conversely, it also aids water movement upwards from depth through a dry soil, helping plant survival and growth."

The workshops were also designed to examine optimal machine set-up for maximum performance with minimum compaction, including ideal ballasting, tyre pressures and wheelslip rates. Around 40 to 60 per cent of land in eastern Europe suffers from compaction as a result of practices from the past 50–70 years, exaggerated by heavy tractors with small tyres.

New technology means this can be addressed, though, suggests Christof: "The workshops helped illustrate the range of Case IH equipment available to help combat the problem, and examined how to operate equipment for best effect, using examples such as driving over a buried egg with a Quadtrac to illustrate how spreading weight minimises its impact.

"Reducing the number of passes made, and ensuring the correct ballasting is used to maximise traction and minimise slip, can help cut compaction. And where appropriate, the greater ground contact area and positive drive of tracked machines including combines.

After generations of ploughing and traversing eastern European fields, compaction layers are restricting yields.

"For those who prefer or require a wheeled tractor, the Optum's high-hp, low weight design means it can be easily ballasted according to the task. And in conjunction with the latest tyre technology, ensuring pressures are correctly set for the work, allows for full exploitation of the capabilities of our wheeled high-hp tractors," says Christof.

Using herpes virus to eradicate feral fish? Carp diem!

By Dr Ken McColl, CSIRO

THEY breed like rabbits and put increasing pressure on our waterways and native wildlife. Yep, we're talking about carp.

Just like rabbits these pesky fish multiply rapidly, reaching huge numbers quickly and are one of the most invasive and damaging pests of our freshwater ecosystems. Biocontrol agents have been successfully used to control rabbits in Australia, and we're confident that a virus that has been killing carp overseas could do a similar job here.

Carp herpes virus

This virus, once known as koi herpesvirus, is now formally known as Cyprinid herpesvirus 3 (CyHV-3). Seven years of CSIRO research, supported by the Invasive Animals-Cooperative Research Centre (CRC), has shown that the use of CyHV-3 as a biocontrol agent could significantly reduce the number of common carp (*Cyprinus carpio*) in our rivers.

Naturally with any talk of a biocontrol agent, there is public debate and speculation. So we thought we'd go fishing for answers to the most common questions.

1. Is it really necessary to control carp in Australia?

First introduced in Australia in 1859, carp became a major pest in the 1960s after the accidental release of a strain that had been adapted for fish farming. Within a few years they established themselves throughout the entire Murray-Darling Basin.

Carp now comprise up to 90 per cent of the fish biomass in parts of the Basin. This is largely attributed to female carp producing up to a million eggs per year, and to the omnivorous fish's tolerance for a wide range of habitats including degraded water. While we may not be able to 'prove' that carp directly caused the degradation of our rivers, their dominance must certainly contribute to the problem. It is unlikely that the Murray-Darling Basin could ever return to its previous glory while carp remain in such high numbers.

Our views in Australia are supported by research from the US. This showed that carp muddy their waters resulting in flow-on effects on plants, invertebrates, bird-life and native fish in shallow lakes. Researchers concluded that common carp damage the ecology of shallow lakes, particularly when carp density reaches levels similar to those in parts of the Murray-Darling Basin.

2. Will CyHV-3 be effective as a biocontrol agent?

CyHV-3 first appeared in Israel in 1998 and quickly spread throughout the world, killing-off common and koi carp. Ironically carp are farmed in many countries and are an important food source. So, while CyHV-3 has devastated carp farming, the overseas experience has demonstrated how it could be used successfully as a biocontrol agent here.

Testing of CyHV-3 in the high-security Fish Diseases Laboratory at our Australian Animal Health Laboratory (AAHL), in Geelong, Victoria, has proven that the same virus does in fact kill Australian carp, and it kills them fast.

The flip side is our rigorous testing to ensure that the virus won't affect native Australian or important introduced species of fish. It has been shown to pose no danger to 13 native species such as Murray cod, various species of perch, eel and catfish, as well as a crustacean (yabbies) and a non-native fish species, the rainbow trout. Our work has shown that there are no clinical or pathological changes in these non-target animals, nor is there any evidence that the virus multiplies in these species.

Carp-free ecosystems will be a breath of fresh air. (IMAGE: Benjamin F. Haith/Shutterstock.com)

A European carp. (IMAGE: Dirk-Jan Kraan/Flickr)

Chickens, mice, frogs, turtles and water dragons have also been tested as representatives of a wider community of birds, mammals, amphibians and reptiles. Again the virus has shown no effect on them which also makes us confident that it won't affect that other major group of mammals – humans.

Based on lessons learnt from past use of viral biocontrol agents for invasive vertebrates, we expect that CyHV-3 will have the greatest impact in the first couple of years after release. After that, its effectiveness may be diminished, but not lost, as virus and host adapt to each other.

Therefore, we need an integrated pest management program that utilises other methods to complement our virus. These include new broad-scale technologies such as 'daughterless' technology to create male-only populations, as well as traditional regional methods such as trapping, the commercial collection of carp, and controlling access of carp to breeding grounds.

3. What happens to the dead carp?

If an image of rivers full of large dead carp floating on the surface is what springs to mind, rest assured that our research includes careful planning and modelling before release and follow-up strategies are recommended.

Carp breed in well-mapped specific sites along the Murray-Darling Basin. The virus is likely to be released in these sites where most carp are juveniles. Not only would this wipe out large populations of carp before they become mature, but bird life will probably clean up large numbers of the immature carp.

Study tours of Japan and Indonesia are part of the Invasive Animals-CRC program to study natural outbreaks of CyHV-3. Researchers will be reviewing the significance of dead mature fish, and strategies for dealing with them.

4. How can we be sure that widespread distribution of the virus is safe for people?

CyHV-3 has devastated carp farming around the world yet despite the large numbers of people working on these affected farms, there has been no evidence of any effect of the virus on them.

We have also exposed mice to CyHV-3, and found no evidence of disease. Mice were chosen as being a representative mammal, just like a human.

And finally, a report to the European Commission by the Scientific Committee on Animal Health and Animal Welfare stated that there is no evidence for ANY fish virus causing disease in humans.

So what's the verdict?

Given our very good understanding of both the biology of CyHV-3 and of carp in Australia, we are optimistic that this carp virus will make a significant impact on carp in this country. And for that, our river systems and native fish will be very grateful.

UPDATE: A carp's tale – you ask, we answer

By Cassandra Leigh and Emma Pyers

Your questions came in thick and quick when you heard we're working on a biocontrol option for managing European carp numbers in Australia. We're not fishing around – we take biocontrol research seriously. So, we sat down with our resident koi carp expert Ken McColl to answer all your burning questions.

How does the herpes virus work?

The virus – CyHV-3 – mainly damages the kidneys, skin and gills of koi carp. Kidney and skin are very important in helping the fish maintain its water balance. Animals living in a freshwater environment need to stop water getting into the body (skin) and to pump out excess water that does get in (kidneys). In affected fish there is a water imbalance which causes a mineral imbalance. Among other things, the latter could affect heart function (although that has not yet been shown in carp). Damage to the gills affects the carp's ability to breathe and this is the cause of death.

After a fish is infected by the virus, the virus multiplies in the fish for about seven days (depending on the water temperature). During this time the fish eats and appears quite normal. It then takes about 24 hours from the first signs of disease (darkening of the skin; reddened gills) until the fish dies.

How is it transmitted?

Most commonly the virus appears to be transmitted by direct contact between fish, but fish can also be infected by virus in the water. The virus alone will never wipe out carp completely; there will always be some survivors. As in any herpesvirus infection in any host, survivors are infected with herpesvirus for life. These are what is known as latent infections, where the virus is present but does not seem to cause any signs of disease. But if a latently-infected animal is stressed for any reason then the virus re-activates and can be spread. This should allow the virus to survive in the carp population.

Can the virus live outside the carp body?

The virus survives for only a few days outside a fish.

How do you know it won't infect other species?

We have done rigorous testing to ensure that the virus won't affect native Australian or important introduced species of fish. It has been shown to pose no danger to 13 native species such as Murray cod, various species of perch, eel and catfish, as well as a crustacean (yabbies) and a non-native fish species, the rainbow trout. Our work has shown that there are no clinical or pathological changes in these non-target animals, nor is there any evidence that the virus multiplies in these species.

Chickens, mice, frogs, turtles and water dragons have also been tested as representatives of a wider community of birds, mammals, amphibians and reptiles. Again the virus has shown no effect on them which also makes us confident that it won't affect that other major group of mammals – humans.

Juvenile carp aggregated below the Menindee Main Weir on the Darling River. (IMAGE: Nigel Harriss, NSW Office of Water)

Will the infected fish be safe for animals and people to eat?

CyHV-3, which was first discovered in Israel in 1998, has devastated carp farming around the world yet despite the large numbers of people working on these affected farms, there has been no evidence of any effect of the virus on them. We have also exposed mice to CyHV-3, and found no evidence of disease.

Mice were chosen as being a representative mammal, just like a human. Finally, a report to the European Commission by the Scientific Committee on Animal Health and Animal Welfare stated that there is no evidence of ANY fish virus causing disease in humans.

What's to stop the virus mutating and infecting other species?

When it comes to understanding the effects of mutations in viruses, work on many viruses over many years has resulted in some general observations. Firstly, some viruses are naturally promiscuous, meaning they will infect a wide range of species (eg. the influenza viruses). Herpesviruses are not considered to belong to this promiscuous group of viruses. In fact, herpesviruses are generally considered to be species-specific, ie. each host species has its own herpesvirus(es).

Secondly, viruses that are species-specific can occasionally jump into new hosts, but these jumps seem to be determined by two factors:

- Virus jumps really only occur between closely-related host species (such as AIDS virus and Ebola virus jumping from non-human primates into humans); and.
- The nature of the genetic material of the virus. Viruses can be broadly classified as RNA or DNA viruses depending on the nature of their genetic material. DNA viruses (like koi herpesvirus) are relatively stable, whereas RNA viruses (like AIDS virus, Ebola virus, influenza virus) are much more likely to undergo mutations that potentially allow these viruses to jump hosts (although, as already mentioned, generally the jump is still into a closely-related species). Some small and very simple DNA viruses may jump species, but by contrast, koi herpesvirus is a very large and complex DNA virus, and as a result they are rarely associated with jumps.

It's worth noting that two viruses have been released in Australia to control rabbits, the Calicivirus (an RNA virus) and before that, the virus causing Myxomatosis (a complex DNA virus). These viruses have been present in Australia for around 20 and 60 years respectively and there is still no evidence of either virus jumping into another host during all that time.

For koi herpesvirus, the important observation is that it has only been found in carp. Carp belong to a group of fish known as cyprinids, and there are no native cyprinids in Australian waterways. The native fish in Australia that are most closely related to cyprinids are the native catfish.

The susceptibility of two different species of native catfish to koi herpesvirus has been tested, and there was no evidence of disease or of virus multiplication in either species.

Won't carp eventually develop resistance to the virus?

Whenever a virus is used as a biocontrol agent, the virus kills large numbers of the target for the first couple of years. But, gradually the virus and host come to a state of equilibrium that allows both to survive. At that point there has been a marked initial reduction in the numbers of the target, and the virus then continues to cause a lower level mortality in the target such that the target numbers never recover to their original levels.

We've seen this happen with both the Calicivirus and the Myxoma virus in their effects on rabbits, and those viruses still do a great job in controlling rabbit numbers in Australia.

What will happen to ornamental fish bred intentionally – are they likely to be eventually infected?

Goldfish are not affected by this virus. But koi carp are completely susceptible, and therefore, for people trying to raise koi, normal biosecurity measures will need to be taken. This may mean treating inflowing water with chemicals, heat, or UV to kill any virus that might be present.

Also, any new fish introduced to an aquarium should be held in quarantine – about two-four weeks for koi (which could be incubating the virus) and any also for other species that may have had contact with carp/koi (they could be inadvertently carrying the virus on their gills or skin even though it will not cause disease in these species).

What about the businesses that rely on carp?

Businesses that harvest carp to use as fertiliser will still be able to do this, as the initial release will mean a lot of dead fish will be available for this purpose. Even as numbers diminish there will still be carp available as the virus alone will not eradicate all the carp, so it's important that we have complimentary control measures, like harvesting, to keep numbers low.

So there will be a lot of dead carp floating around?

The release would be coordinated at a location and time that coincides with breeding, so it would initially kill young fish before spreading throughout the waterways. The dead fish will be an easy food source for many bird species, and in addition will still be able to be harvested for fertiliser.

When will the virus be released?

It is difficult to place a timeline on any biocontrol program. We'll continue to undertake studies with non-target fish species to ensure the virus remains species specific and only affects carp.

Following this, the Invasive Animals CRC (funding body) will work with the relevant parties to progress the biocontrol agent through the regulatory/approval processes.

EDITOR'S NOTE: The analysis of the risks and opportunities of the release of the virus will be finalised by late 2018. ■

The advantage of being in tune

WORKING on the formula of performance, economy and efficiency, over the past year Advantage Tuning has been turning screws to increase all three for farmers all over Australia. With rising input costs, fuel economy and machine efficiency have never been more important to a farm's bottom line. Lowering fuel burn rates increases not only the grower's profit margins, but increases engine longevity.

The Challenger pictured was tuned by Advantage Tuning on the Beef Road between Middlemount and Dysart late last year. Previously, the machine was using 90 litres per hour at a 100 per cent engine load, and was physically unable to move up to a higher gear. After a tune and service from Advantage Tuning it was able to utilise an additional two gears, and is now operating at 300 rpm lower than prior to the tune.

In addition to this performance increase, hourly diesel usage dropped by over 22 per cent to 70 litres per hour. Over a typical 10 hour work day that's a saving of 200 litres of diesel, and an increase in performance which will undoubtedly increase the life of the engine.

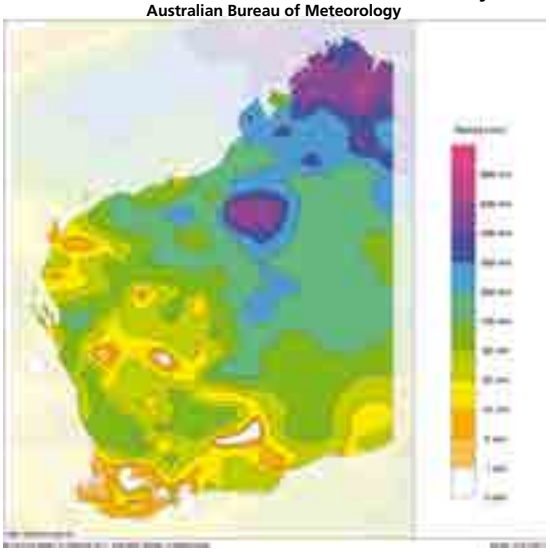
For more client testimonials and more information on their services search 'Advantage Tuning' on Facebook, visit www.advantagetuning.com.au or call Andy Webb on 0438 517 978. ■

District Reports...

January–February 2017

Western region

Western Australian rainfall totals (mm) – January 2017
Australian Bureau of Meteorology



NORTH

Harvest was generally completed before Christmas for most growers but some were still going into the New Year. And growers were generally very happy with their crop yields but frost was widespread and severe on some farms. Quality downgrades due to frost were a small percentage of total receivals for the district but some individual growers did have quality problems due to frost-affected grain.

The Geraldton Port zone finished with record receivals and these record yields helped to make up for the lower grain price. CBH did have to temporarily close some grain segregations to allow shipping and movement of grain to keep grower deliveries rolling in.

As outlined in my previous report, all crops performed very well with canola and lupins being at record yield levels on most farms. Grain protein levels were generally very low for the 2016 crop due to the high yields achieved in most paddocks.

Since harvest, conditions have been dry across the whole region with weed control not being required on most farms.

Some rain is expected in coming days due to a developing tropical low off the coast – hopefully rainfall tallies are high and growers get a chance to do some deep ripping.

Peter Norris, Agronomy For Profit, Geraldton
January 26, 2017

District Reports...

January–February 2017

SOUTH COAST

Seasonal conditions on the South Coast of WA for the past two months have been very dry. This is quite uncharacteristic for the region but most growers have welcomed the dry spell as it means one less summer weed spraying – which is a nice cost and time saving.

The 2016 harvest weather was very good allowing most growers to finish one or two weeks before Christmas. Grain receivals currently sit at 2.66 million tonnes – this is better than 2015 and on par with the 2013 record.

The tonnage received was quite surprising given the amount of waterlogging on the coast and some pretty widespread frost damage across our port zone.

Most growers have had some very welcome time off to recharge for the 2017 season. Those back at work are currently completing a range of activities including lime and gypsum spreading, claying, delving and spading non wetting sands, deep ripping, surface drainage and tram line renovation.

Currently low grain prices are making growers review crop rotations and fine-tune budgets to help increase the bottom line.

Quenten Knight
Precision Agronomics Australia, Esperance
January 23, 2017

Southern region

SOUTH AUSTRALIA

The main points

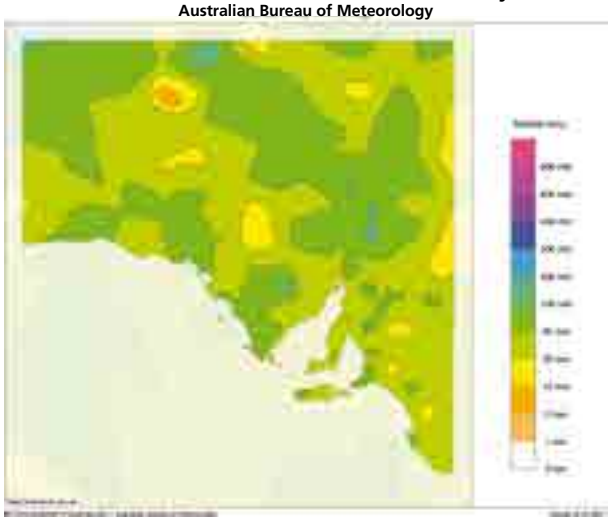
- The 2016–17 winter crop is projected to be in excess of 10.5 million tonnes – the biggest ever produced in the state;
- Because of excellent yields, growers generally recorded favourable financial results despite poor grain prices; and,
- Very good summer rainfall is adding to subsoil moisture reserves which may prove to be invaluable later in the year for this coming season's winter crops.

Heavy rainfall and warm temperatures

The Bureau of Meteorology reports that with the passage across the state in late December of a deep low pressure system, it was a wet finish to an overall wet year for South Australia. There was record high daily rainfall between December 27 and 29 for many locations.

With much of the state reporting more than double the monthly average rainfall, many sites had their wettest December

South Australian rainfall totals (mm) – January 2017
Australian Bureau of Meteorology



on record and the wettest December in several decades for many other locations.

For the state as whole, it was the wettest December on record, surpassing the previous wettest December set in 1988.

Both day and night temperatures started off generally near average at the beginning of December, but heatwave conditions at the end of the month saw temperatures well above average during the Christmas period.

January brought with it a continuation of higher than average rainfall in most cropping regions of the state (see accompanying rainfall chart). Monthly rainfall recordings of 100 mm and more have added to subsoil moisture reserves. Provided summer weeds are controlled, this will provide an excellent moisture buffer for the 2017 winter grain crop.

VICTORIAN MALLEE

The 2016 season was exceptional, both for rainfall and yields. The region produced some of the largest crops we've ever seen, and for some younger farmers something they've never experienced previously.

Hay yields also broke some records with baling morphing into harvest meaning many farmers were juggling baling and harvest at the same time.

BCG's Wintersteiger harvesting a very impressive three tonne to the hectare canola crop in the Manangatang district.

District Reports...

January–February 2017

Wheat yields in the Mallee reached up to 7.5 tonnes per hectare, some of the highest ever recorded.

Severe lodging in barely crops caused issues at harvest, particularly in Compass barley which lodged but was also subject to head loss. Secondary green re-growth/tillers further added to the frustration with a few growers windrowing barley to ripen naturally in the rows.

Farmers who planted large areas of pulses were rewarded with exceptional yields of 2.5 tonnes per hectare for lentils. Canola responded well to the favourable spring yielding 2.5–3.0 tonnes per hectare whilst cereals ranged from 4–6 tonnes per hectare.

Anecdotally, grain protein per cent was low across the region due to insufficient nitrogen amounts applied prior to the spring rainfall. The most common wheat quality was APW but there were a few cases where H2 was reached.

Record low cereal prices meant that growers invested in silo bags, additional storage and home-made bunkers. There is a still large portion of grain in the Mallee being stored on-farm, waiting for the price to rise in the future.

Patchy rainfall events during harvest prolonged the process but most headers seemed to be back in the shed just in the nick of time for Christmas Day or for the fireworks on New Years Eve.

Summer rainfall has been minimal with falls of around 10–20 mm to date. This has been enough in some cases to warrant spraying for summer weeds.

Paddock planning is currently underway and many farmers will being soil sampling in February and March. Seed will also be cleaned and graded in preparation for sowing – it seems to be

Seasonal rainfall across the grain regions – 25 year averages and year to date

Brought to you in association with JOHN DEERE

	25yr Annual Average (mm)	2017 rainfall to date (mm)	Summer		Autumn		Winter		Spring	
			25yr Annual Average (mm)	2016–17 to date	25yr Annual Average (mm)	2016	25yr Annual Average (mm)	2016	25yr Annual Average (mm)	2016
Emerald Qld	553	29	255	92	99	22	70	262	122	68
Toowoomba Qld	667	92	277	126	129	96	88	205	177	158
Roma Qld	574	66	254	116	113	30	78	132	131	155
Goondiwindi Qld	615	63	256	126	119	52	103	142	140	163
Narrabri NSW	628	23	226	50	112	79	130	266	165	201
Gunnedah NSW	638	24	224	119	106	53	129	172	181	189
Dubbo NSW	615	13	198	152	122	97	135	307	160	248
West Wyalong NSW	461	11	120	53	80	108	125	287	135	254
Wagga Wagga NSW	554	14	132	84	115	155	153	216	152	260
Swan Hill Vic	321	13	71	17	64	82	87	94	99	140
Bendigo Vic	514	41	108	10	106	131	160	230	143	249
Horsham Vic	379	38	77	70	71	87	122	138	108	154
Lake Bolac Vic	524	41	113	67	102	132	156	189	152	259
Murray Bridge SA	374	12	67	68	81	74	122	136	103	155
Kadina SA	347	36	56	124	82	137	114	158	91	116
Cummins SA	400	32	50	59	94	136	172	197	83	93
Esperance WA	622	5	80	31	146	187	250	233	143	153
Wagin WA	396	0	43	44	98	163	166	133	88	63
Northam WA	399	0	40	14	89	184	188	171	83	55
Mingenew WA	354	5	27	5	93	106	175	208	60	41
Moora WA	383	0	41	10	88	113	185	242	69	52
Mullewa WA	325	5	47	8	97	67	133	162	48	18

Last rainfall reading January 23, 2017.

District Reports…

January–February 2017

looming quicker than usual, most likely due to the late harvest wrap up.

Results from BCG research trials conducted in 2016 at multiple locations over the Mallee, will be made available on February 17 at the annual BCG Trials Review Day. Fortunately, a wet and cool spring has resulted in some excellent research messages for farmers.

Ciara Cullen, Birchip Cropping Group
January 20, 2017

NSW OVERVIEW

Rainfall across NSW during December was near average across 57 per cent of the state and above average across 33 per cent. Areas of the north coast, northern tablelands, Hunter valley and the far south west received below average rainfall. Above average rainfall occurred across areas of the far west, the central west and the Riverina.

Pasture growth slowed during December across most of western NSW, the north west, the western edge of the Riverina, areas of the upper Hunter and the north of the central west.

Growth was also slow across areas of the coast, but remained moderate across most of the Monaro, tablelands and slopes.

Pasture growth was moderate across the eastern and central Riverina, the far north west and the south of the central west.

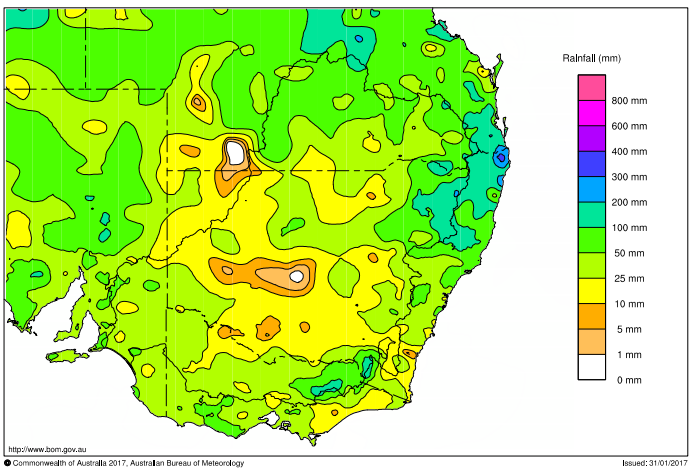
Stock condition remained generally good. Grass seeds continued to be a problem in many areas.

Summer crops

Warmer temperatures during mid-late December accelerated summer crop growth and increased crop water requirements, after a slow start in some areas. In the south, above average rainfall has benefitted the growth of summer crops and lucerne. Crop development has been slightly delayed by late sowing and cooler conditions in early December.

The yield potential for rice is average to above average. For dryland sorghum in the north west the yield outlook in early February was looking good. There is a high chance of above average yields providing average to above average rainfall is received during the remainder of the growing season. The yield potential of irrigated crops is high, despite the current hot, dry conditions. The cotton production forecast is for 4.4 million bales, but may be revised down if the current conditions continue.

Murray–Darling Basin rainfall totals (mm) – January 2017
Australian Bureau of Meteorology



Seasonal outlook

The Bureau of Meteorology's rainfall outlook for January to March indicates drier than normal conditions are likely across most of NSW, with a near-equal chance of drier or wetter than normal conditions across the west and areas of the south. Temperatures are likely to be warmer than normal across most of NSW, with a near-equal chance of cooler or warmer than normal daytime and overnight temperatures in areas of the far west and areas of the south.

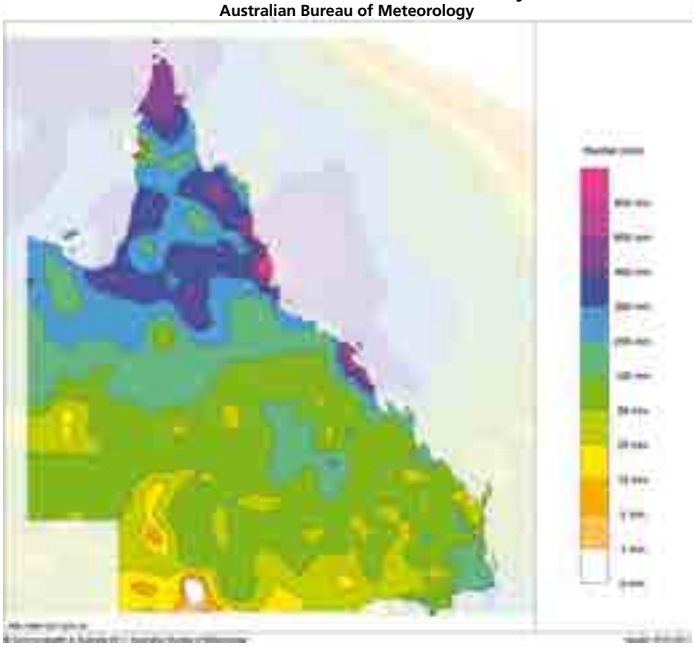
A survey of the major climate models in early January showed some variability in the rainfall outlooks for the January to March period. Most (71 per cent) favoured a generally near-neutral outlook (that is, a near-equal chance of drier or wetter than normal conditions). Two models favoured a generally wetter outlook and two a generally drier outlook. The Bureau's seasonal outlook for the period was included in the latter.

For temperature, most models (69 per cent) favoured a warmer than normal outlook, with four favouring a generally near-neutral outlook. Model accuracy tends to be lower into early autumn.

NSW Department of Primary Industries
January 18, 2017

Northern region

Queensland rainfall totals (mm) – January 2017
Australian Bureau of Meteorology



District Reports...

LIVERPOOL PLAINS

The cotton season started off slowly on the Plains with a lot of cold, short days. But most of the sorghum seemed to go in on time with a majority of the planted area having a full moisture profile. A large number of growers had issues with germination percentages – primarily due to the wet soils at planting time – resulting in lower plant stands.

There were patchy storms around Christmas and the New Year period with some great rainfall totals received. If you were lucky enough to be under the rain events, the establishment of cotton and sorghum crops has been very good. But for the summer crops to reach their full potential, it would be ideal to get some significant rain in the coming week or so.

Lauren McGavin,
Precision Seeding Solutions, Premer
January 23, 2017

MR Scorpio (on the right) and MR Taurus (on the left) were planted on the same day of a Liverpool Plains' sorghum variety trial.

Liverpool Plain's sorghum crops are looking for some timely rain.

DARLING DOWNS

Weather conditions

The weather has been difficult with hot temperatures and only storm rainfall, which in many cases has not wet up the soil. Rainfall has also been very patchy with some growers receiving good rain but almost no rain in other areas, so for the past three months, total rainfall has varied from 60 mm to well over 200 mm. The long term average for the region is about 210 mm for November to the end of January.

These photos taken in mid January illustrate the difference between sorghum grown on short fallow ground (TOP) and on long fallow ground (BOTTOM). The difference is simply the amount of stored soil moisture available – a critical factor during this very difficult summer season.

District Reports...

January–February 2017

Summer crop

The status of all dryland crops is determined by how good the stored moisture level is, so those crops planted on last summer's cropping ground are struggling, whilst genuine long fallow ground has reasonable looking crops. The mid-summer plant has been limited and dependent on where the rain fell, with corn, mungbeans and some soybeans planted. But a number of growers have not been able to plant at all.

The spring sown sorghum crops are close to harvest with dessication underway. Silaging has been an option for failing corn crops, and spring sown sunflowers are drying down after a hectic 'photographic tourist' season. Summer planted beans are emerging well where planted in good moisture, despite the heat.

The areas planted are well back on last summer with sorghum only 55 per cent of last season, although corn and cotton have increased with attractive contract prices, and the irrigated area is also back due to reduced water availability.

There was heavy heliothis pressure in early sorghum following on from high pressure in the chickpeas and wheat last winter. And although moving out of sorghum, heliothis pressure has continued in the cotton, where mirids have also been constant.

In sunflowers and sorghum there have been high numbers of Rutherglen bugs, which have caused some problems in the flowering and early grain fill stage, and any sorghum flowering now has midge.

The early corn is being harvested with some poor yields and fungal infections, due to the weather stresses and the heat during pollination. The heatwaves have affected quality in all the grain crops. Spring mungbeans are being dessicated with low yield potentials, poor quality and high virus activity.

There has been some late summer crop planting in mid to late January, with growers hoping there will be no early frosts. Many of these crops are on limited stored moisture and will need good rain to reach potential, The late summer planting is about 50 per cent of the expected area.

2017 winter outlook

As there are plenty of paddocks which were planned for summer crop unable to be planted because of the dry, growers are looking ahead to winter options.

On the current expected prices, another large area of chickpeas will be planted, and there is discussion about niche crops such as durum wheat, whilst the barley plant is expected to be back.

A lot will depend on projected prices.

Hugh Reardon-Smith
Agronomist, Landmark Pittsworth
January 20, 2017

CENTRAL QUEENSLAND

Dry and hot, with sporadic storm rains, pretty much sums up December and January for most regions of Central Queensland.

There has been a small area of spring mungbeans around the Dawson and Callide districts that have battled through with the tough conditions.

Continuing dry conditions and limited soil moisture reserves has meant there has been no district-wide summer sorghum planting to date – and the optimum planting window for sorghum in CQ closes around mid-February. With little optimism that substantial profile-filling rain will fall before mid-February, this 'unused' sorghum area could potentially add to an above average plant of wheat and chickpeas later in the season.

Big year for chickpeas?

With above average prices on offer for forward selling of chickpeas – along with the currently favourable April through July seasonal forecast from BOM – growers will be keenly planting this winter crop if we get the rain.

But the region's hot and generally dry summer conditions have been ideal for irrigators. Picking of irrigated cotton will commence in the next week or two and yields look to be excellent. Unfortunately, dryland cotton has struggled.

Here's hoping for some good soaking rains (after the cotton pick of course) to fill up depleted soil moisture reserves and to provide the foundation for a successful winter crop in Central Queensland.

Contributed February 1, 2017

ANSWER TO IAN'S MYSTERY TRACTOR QUIZ

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