AUSTRALIAN GRAIN

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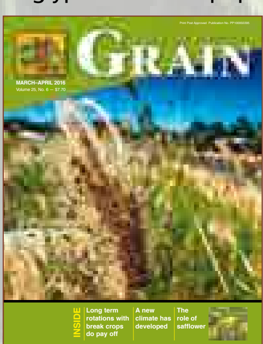
## FRONT COVER

In an unwanted world first for Australia, four populations of the increasingly widespread weed, feathertop Rhodes grass, have been confirmed as resistant to glyphosate. This popular herbicide is normally effective on actively growing FRG seedlings but when the weed begins to tiller, it is tolerant of very high rates. See page 28.




(PHOTO: Agronomo)

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# Focus Sections

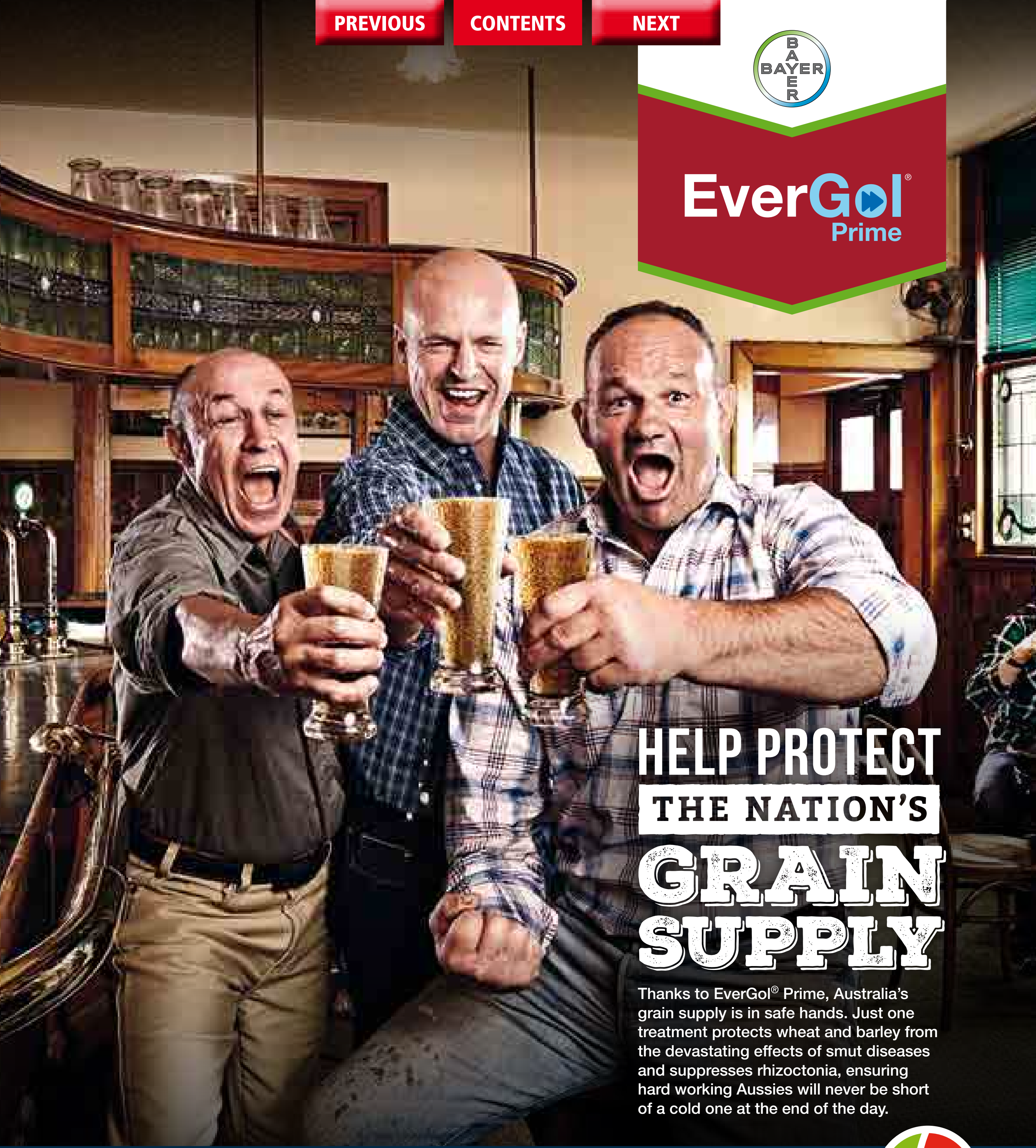
## Southern Australia Focus

***Covering cropping systems of Southern NSW, Victoria, South Australia, Western Australia and Tasmania***



## Northern Focus

***Covering Northern NSW and Queensland***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Thanks to EverGol® Prime, Australia's grain supply is in safe hands. Just one treatment protects wheat and barley from the devastating effects of smut diseases and suppresses rhizoctonia, ensuring hard working Aussies will never be short of a cold one at the end of the day.

# Editorial… Lloyd O'Connell

EVEN after a dry and dispiriting spring, our official government commodity forecaster, ABARES, has estimated that grain farmers across Australia managed to deliver an above average national tonnage of winter grains and oilseeds in the 2015–16 season. Around 39.5 million tonnes tipped the scales – or 3.5 million tonnes (10 per cent) better than the 10 year national average for winter crops.

The result is even more impressive when you consider that this above average production came from an Australia-wide total area of 22 million hectares – almost bang on the 10 year average of 21.9 million hectares planted to winter crops.

This tells me that we're getting better at growing our crops, whatever the season may throw at us. In short, we are very good at adapting to changing circumstances and probably just as good at adopting new methods, technologies and crops if they merit a place in our farming systems.

This issue of *Australian Grain* has a number of articles which detail new opportunities presented by changing climate patterns, very clever engineering or new and emerging markets.

Dr David Stephens details the observed shift in climate patterns across the national grainbelt since the turn of the century (page 6) while the AGFACE research program is helping farmers keep ahead of the climate change curve by identifying the physiological and yield changes various crops will potentially undergo (page 45).

On the cold hard steel side of things, researchers from the Australian Herbicide Resistance Initiative proudly detail the very collaborative road from an individual farmer's idea 20 years ago about how to tackle herbicide resistance, through to industry wide R&D and financial support and ultimately arriving at the commercialisation of the integrated Harrington Seed Destructor (page 35).

And if that isn't enough 'new stuff' to ponder in coming months, why not consider growing safflower. This is a winter oilseed which largely flies under the radar. The crop has a number of rotational benefits – but market development work needs to be done. For example, the unique properties of the acid extracted from oleic safflowerseed shows promise for biodiesel production (page 39).

## Greenmount farm study tours

We have four trips on offer in the second half of this year – and all are to destinations well off the beaten farming and cultural track. If it's the farms, cultures and scenic wonders of Alaska, Africa, Almaty or Arnbjargarlækur you have on your bucket list, *Greenmount Travel* has a study tour to take you there. All of these tours have their own very unique logistical challenges so we need to hear from you as soon as possible. For the latest itineraries see:

***www.greenmounttravel.com.au***

Hope everyone enjoys a timely and widespread Autumn break.

AUSTRALIAN GRAIN

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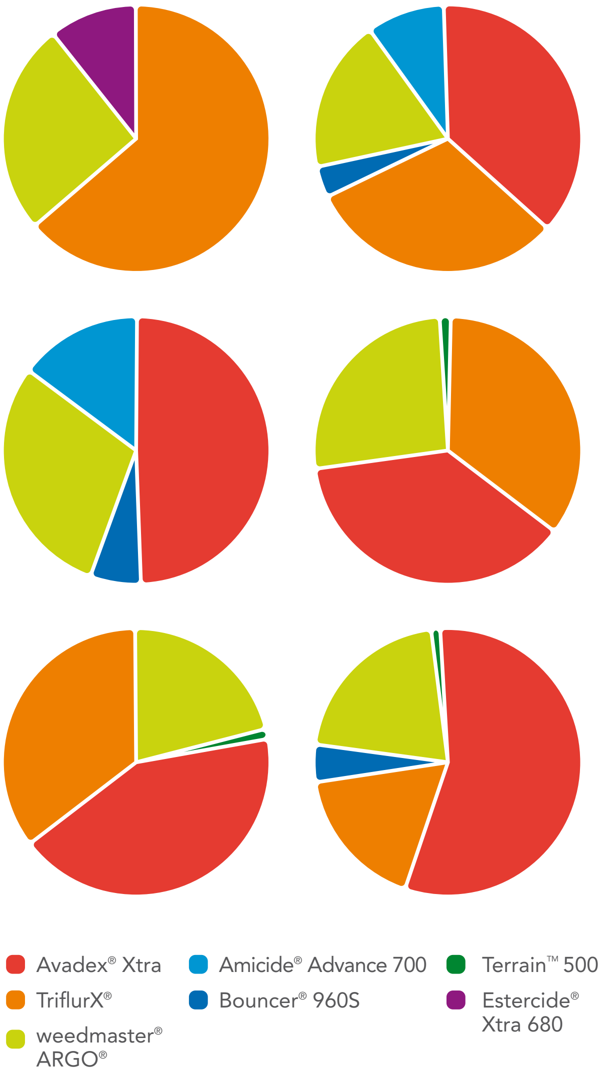
# In this issue…

# Discover the herbicide mix that works best for you.




Wherever you live, and whatever crop you grow, each and every crop is unique. From the development of herbicide resistance, weather variation to paddock history, there are so many considerations when investing in the right herbicides for the coming season.

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# New Australian climate developing

**By the Australian Export Grains Innovation Centre**

A NEW climate is emerging in Australia, according to new maps released by the Australian Export Grains Innovation Centre (AEGIC). AEGIC has analysed data from more than 8000 Bureau of Meteorology stations around the country and discovered that traditional rainfall zones have changed significantly since 2000.

The findings are based on research by AEGIC agro-meteorologist Dr David Stephens. David said the new analysis revealed striking changes to the Australian climate over the past 16 years.

"Since 2000, there has been a general increase in summer rainfall across Australia, and a corresponding decrease in winter rainfall, leading to shifts in rainfall zones extending for hundreds of kilometres," David said.

"Rainfall between May to October over much of the heavily populated regions of southern Australia has decreased 10 to 30 per cent, while summer rain has increased up to 40 per cent in some areas.

"This change in climate has major implications for farming and pastoral systems as the profitability of different crop types changes, disease risk changes, and the composition of rangeland grasses changes with stocking rates."

### Shifts in rainfall zones since 2000 (Figure 1)

- For regions with a Mediterranean climate, winter (and winter dominant) rainfall zones are contracting in a south-westerly direction.
- In northern and eastern areas, summer (and summer dominant) rainfall zones are expanding southward.
- Between these regions, there is a uniform rainfall zone where summer and winter rainfall are similar. The southern boundary of this zone has shifted from southern/central New South Wales down into central Victoria and the Mallee region of south-east South Australia.
- In the south-west of Western Australia, a uniform rainfall zone has appeared along the eastern edge of the wheat-belt from Beacon to Southern Cross to Grass Patch.
- Most rainfall zone boundaries have typically shifted 100 to 400 km over the past 16 years. The only expansion of the winter rainfall zone has occurred in southeast Tasmania where winter rainfall has become more reliable.

### Earlier winter crop sowing

David said the analysis highlighted that the shift to earlier sowing of winter crops measured recently by AEGIC should

**FIGURE 1: Australia's new climate zones**

**OLD CLIMATE**



**NEW CLIMATE**


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continue because early sown crops take advantage of any additional summer soil moisture.

"They also experience a lower evaporative demand through the growing season, and are less affected by declining rain in October and rising spring temperatures," he said.

"In pastoral regions in much of Western Australia, increasing summer rain with a reduction in rainfall variability has assisted perennial C4 (tropical) plants at the expense of C3 (temperate) grasses (especially in southern areas), while in central and northern Queensland, an increase in rainfall variability has been detrimental on pasture production and stocking rates.

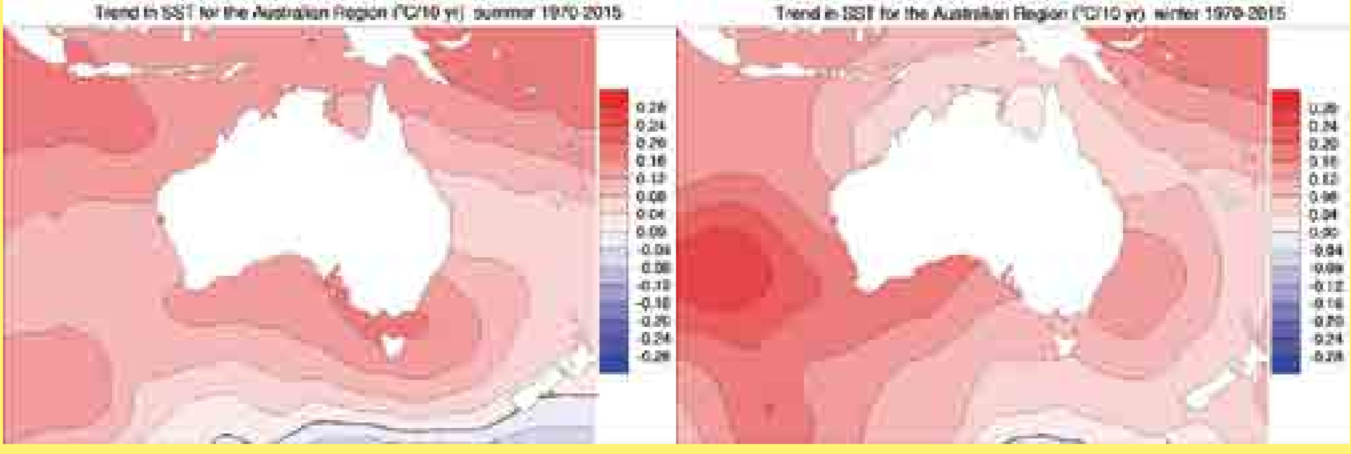
"Australia is going to need some of the most water-efficient farming systems in the world to mitigate the effects of a drier and warmer climate in Southern Australia. Research in this area is vital because Australian crop yields have been among the most affected by climate change compared to other grain exporting nations," David said. ■

## WHAT'S BEHIND THESE CLIMATE CHANGES?

These climate changes appear to be related to changes in barometric pressure, sea surface temperatures and upper level westerly winds.

- In the mid-1970s, there was a weakening of the Indian Ocean Trough to the west of Perth which appears to be related to a decline in winter rainfall since then. In the 2000s, this trough has weakened further in conjunction with strengthening high pressures over Australia.
- In addition, sea surface temperatures have warmed in all seasons, which is beneficial for summer rainfall (Figure 2).
- However, a more marked warming in oceans west of Perth in winter has an inverse relationship to rainfall and has contributed to weaker cloud-band activity in recent years.
- At a Hemispheric scale, one of the drivers of weather is the temperature gradient between the equator and the South Pole. This gradient dropped at the beginning of the 2000s as westerly winds in May–July weakened over Australia."
- The variability in annual rainfall across Australia has changed since 2000. Reduced variability in some regions is due to the loss of wet years, as in south-west Australia, or more consistent average to above average rain, as in the north-western parts of the country and southern South Australia."
- In contrast variability in annual rainfall has increased in inland Victoria, southern New South Wales and much of central Queensland.

**FIGURE 2: Trend in sea surface temperatures: 1970–2015** **(Charts courtesy of Bureau of Meteorology)**



# Taking a long term view of crop rotation pays off

By Roger Lawes[1] – CSIRO

## AT A GLANCE…

- In the short term (one to two years), it is often best to grow the most profitable crop available, regardless of the future costs or benefit.
- A long term view changes the economic perspective as optimal profits decline from $305 to $266 to $183 per hectare per year for a 3, 5 and 10 year optimisation with high wheat ($350 per tonne) prices.
- Lower returns are generated over the long term because the intangible costs of dealing with weeds and disease are taken into consideration, and these are hidden in a short term simulation.
- In the long term, it pays to crop less intensively, manage the weed seed bank and manage the nutrient status under low prices. But as wheat prices increase, the number of breaks decreases, regardless of the timeframe.
- The weed seed bank triggered the need to grow a break crop.

Short term rotation planning artificially inflates returns because the longer term costs of good weed and disease management aren't considered.

THE decision of when to grow a break crop as part of a cereal rotation is complex. At one level, it is widely acknowledged that break crops enhance the yield of subsequent cereal crops by increasing nutrient supply, interrupting disease life cycles and allowing the farmer to use different weed control options. But when viewed on a single season basis, break crops may not appear profitable in many situations due to either low price or low yield.

For example, in Western Australia, lupins were recently valued at $200 per tonne, and potentially unviable at that price. Similarly, in drier climates, break crops like canola and chickpeas have failed during droughts. Therefore, single season gross margins would suggest farmers can generate superior returns by growing continuous cereals.

Simple gross margins ignore future returns, and concepts such as future weed control costs, the effect of disease and changes to nutrient supply. Managing these biotic stresses often leads to improved cereal yields, and higher economic returns for similar or lower levels of input.

As a result there is a dichotomy between a cereal dominant rotation that maximises immediate returns and another that includes break crops and focuses on the longer term economic payoff. This is often influenced by commodity prices and the extent of the biotic stresses present in the paddock.

Recently, Kirkegaard and Ryan (2014) coined the term 'break crop trigger' for defining the biotic conditions when a particular break crop should be grown. But this should also include the planning horizon and commodity price of the break crop.

This article explores the impact that the planning horizon, and commodity price has on the optimum number of break crops grown, and consider how these factors alter the trigger point of a weed population that force another break to be included in the crop sequence.

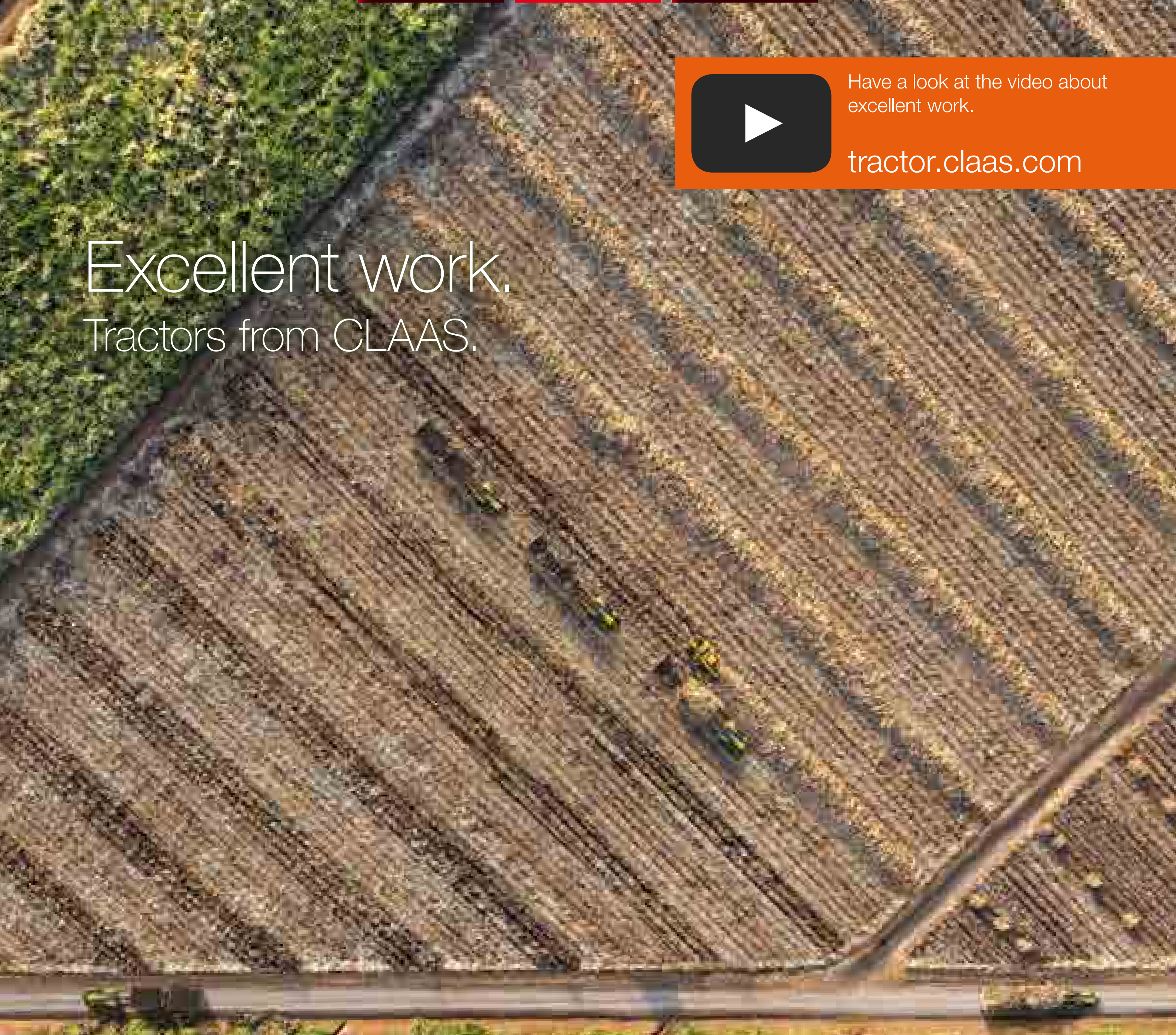
## How the research was done

We used the Land Use Systems Optimiser (LUSO) – a computer model – to quantify the costs and benefits of including break crops in the rotation. We chose the Kojonup region of WA and the input parameters were generated via consultation with local growers and the APSIM crop simulation model. We parameterised the LUSO, for canola, lupins, managed legume pasture and wheat (Table 1).

LUSO is a bio-economic state and transition model that integrates the effects of weeds, disease, nitrogen dynamics and crop yields; and determines the economically optimal rotation from a given set of crop or pasture choices. Each crop or pasture influences the weed populations, disease populations and nitrogen dynamics. The model can be used to explore strategic

**TABLE 1: Land uses and economic parameters defined for the LUSO analysis**

| Enterprise | Yield (t/ha) | Low price ($/t) | High price ($/t) | Cost ($/ha) | N requirement (kg/ha) | Weed survival (0–1) |
|---|---|---|---|---|---|---|
| Wheat | 3.0 | 270 | 350 | 250 | 160 | 0.05 |
| Lupins harvested | 1.5 | 270 | 270 | 200 | 0 | 0.05 |
| Sprayed pasture | 3.0 | 0 | 0 | 80 | 0 | 0.03 |
| Canola | 1.3 | 550 | 550 | 250 | 120 | 0.03 |
| Lupins manured | 1.5 | 0 | 0 | 150 | 0 | 0.03 |
| Pasture | 3.0 | 90 | 90 | 100 | 0 | 0.03 |


Have a look at the video about excellent work.
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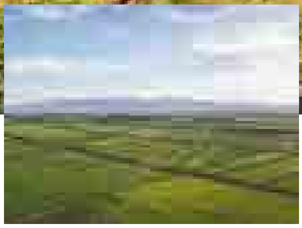
Excellent work.
Tractors from CLAAS.





Trials and simulations have shown that break crops need to be included in the rotation to maintain long term profitability.

and tactical crop rotation strategies and explore how risky particular rotation sequences are.

The optimal rotation is evaluated over 3 years, 5 years and 10 years. These optimisations were conducted to determine whether more break crops were selected when the planning horizon gets longer with low and high initial weed pressures. Each scenario was run at a high wheat price ($350 per tonne), that would automatically favour an intensive cereal crop sequence and at a low wheat price ($270 per tonne), where the gross margin for wheat is less favourable.

In order to examine the 'break crop trigger' the starting seedbank was increased from the initial population of 50 seeds per m$^2$ at increments of one seed per m$^2$ to determine when the starting seedbank brought about a change in the crop sequence. We evaluated this trigger under low and high wheat prices.



## What we found

### Over the short term

For the short (three year) planning horizon with high wheat prices a continuous wheat sequence was selected that generated $305 per hectare per year (Figure 1). For this particular crop sequence, wheat yields declined from 2.64 tonnes per hectare in year one to 2.39 tonnes in year three.

The decline in yield occurred because the disease impact increased from 5 per cent in year one to 14 per cent in year three. The losses due to weeds increased from 7 per cent in year one to 8 per cent in year three, and the continuous wheat system left a residual seedbank that increased from 50 to 305 seeds per m$^2$.

The decline in wheat yields resulted in a steady decline in annual returns from $364 per hectare in year one to $250 in the final year of the crop sequence.

With low wheat prices, a wheat, canola, wheat, sequence was selected and it generated a cumulative profit of $135 per hectare per year. When cereal prices were low, and canola was grown, the steady decline in annual profit did not occur.

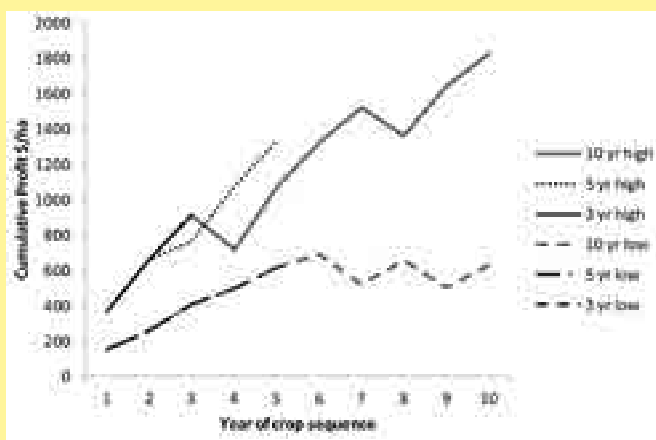
### Over the mid term

For the mid (five year) simulation of crop sequences, with high wheat prices, a wheat, wheat, canola, wheat, wheat sequence was selected. After five years, this sequence generated a profit of $266 per hectare per year. Wheat yields declined from 2.64 tonnes per hectare in year one to 2.50 tonnes in year two.

The canola crop managed the disease, and wheat yields in years four and five were equivalent to those of years one and two. The weed population, and yield loss due to weeds had increased from 7 per cent in year one to 10 per cent by year five and at the conclusion of the crop sequence, 972 seeds per m$^2$ were returned to the seedbank.

Annual returns declined from years one to three, when a canola crop was grown. Profits increased after the canola crop before declining again in the final year of the crop sequence (Figure 1).

**FIGURE 1: Cumulative profit in dollars per hectare for the the 3, 5 and 10 year optimal crop sequences with low and high wheat prices. The dominant crop is wheat. Pronounced dips indicate that a pasture was grown.**



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*As compared to planting with no guidance system, using a 12 m planter. Results may vary based on conditions.

**In the short term, growing the most profitable crop obviously returns the most profit. But after about three years, a break crop needs to be grown.**

With low wheat prices the crop sequence changed to wheat canola wheat canola wheat for a return of $123 per hectare per year. In this scenario, weeds and disease were managed and wheat yields declined from 2.64 tonnes per hectare in year one to just 2.62 tonnes in year five.

This crop sequence mimicked the start of the three year crop sequence.

### Over the long term

With the long (10 year) crop sequence, wheat crops were grown for three years, and then a managed pasture – that controlled weeds – was grown. This was repeated, so over a 10 year period, two sprayed pastures were grown and eight wheat crops were grown for an annual return of $183 per hectare per year.

This particular crop sequence managed the weed burden until the tenth year, when the seedbank increased to 1300 seeds per $m^2$. Wheat yields were reduced to 2.46 tonnes per hectare in the final year of the sequence.

The pasture was expensive to grow, and generated a loss of $230 per hectare. But nitrogen from the pasture contributed to substantial profits in years five and nine of the crop sequence (Figure 1).

With low wheat prices a complex crop sequence of wheat, canola, wheat, canola, wheat, wheat, pasture, wheat, pasture, wheat, was selected for a return of $62 per hectare per year.

The first three and five years of this sequence mimicked the sequence selected by the three and five year simulations. But after that time, weeds became a problem and were again managed with a sprayed pasture (Figure 1).

### When to grow a break crop?

The 'break crop trigger' for the weed seed bank depended on both the wheat price and planning horizon. For both high and low wheat prices the trigger to grow an additional break crop decreased as the planning horizon increased.

Furthermore, for a given planning horizon, under low wheat prices the trigger to grow a break was less than under high wheat prices.

Under high wheat prices the optimal crop sequence changed when the starting conditions for the weed seedbank increased from 50 to 750 seeds per $m^2$ for the three year crop sequence. A sprayed pasture replaced the second wheat crop in this scenario.

For the five year rotation, the canola crop was replaced by a sprayed pastured in the second year when the initial weed seed bank increased from 50 to 148 seeds per $m^2$. The long term crop sequence altered when the starting seedbank increased from 50 to 131 seeds per $m^2$. The number of wheat crops declined by one, and the number of pastures grown increased from three to four.

Therefore, with high wheat prices, the trigger for an additional break crop declined from 750 to just 131 seeds per $m^2$ when the planning horizon changed from 3 years to 10 years.

For the low wheat price scenario, a crop sequence change occurred when the weed seedbank increased from 50 to 557 seeds per $m^2$, where a pasture replaced the canola. This switch occurred in the five year sequence when the starting seedbank increased from 50 to 158 seeds per $m^2$.

Pasture again replaced canola in the 10 year sequence when the starting seedbank was 82 seeds per $m^2$.

## To sum up

Short term planning of crop rotations artificially inflates returns, because the long term costs of weeds and disease are not accounted for. Over time, break crops or pastures need to be grown to keep weeds and diseases in check. Although these practices may seem expensive, they are necessary to ensure paddocks remain profitable, particularly if wheat prices are low.

As wheat prices increase, the number of breaks decline, again demonstrating that the opportunity cost of not growing or growing a wheat crop is an important driver, regardless of the planning horizon.

As the planning horizon increases, and the price of wheat decreases, the number of weed seeds necessary to trigger a break crop or pasture decrease. So, as profit margins tighten, the need to successfully manage the weed seed bank through rotation increases and this explains why the rotation under low wheat prices was similar for the 3, 5 and 10 year run.

In the short term, it is more profitable to grow the most profitable crop, but at some point – usually after three years – a break crop will need to be grown, and they should continue to be grown to maintain the profitability of the system.

**[1]CSIRO Agriculture, PMB 5, Wembley, WA 6913**

**The Grains Research & Development Corporation (GRDC) is gratefully acknowledged for its financial support of project CSA00029.** ■

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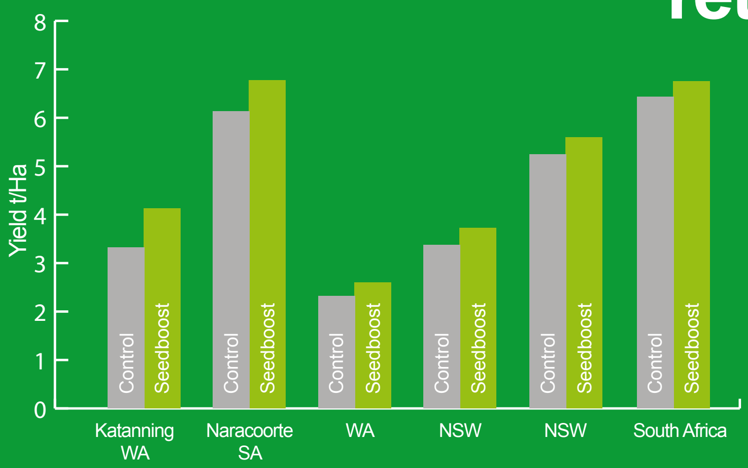


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# Developing wheat with cholesterol lowering properties

By CSIRO

A RECENT breakthrough in our understanding of how beta-glucan structure is controlled may enable the development of healthier wheat grains with higher levels of soluble beta-glucan – a special type of dietary fibre that can help lower blood cholesterol.

### Making wheat healthier – the challenge

Barley and oat grains contain high levels of soluble beta-glucan which can lower cholesterol reabsorption in the gut leading to healthier blood cholesterol levels and lowering the risk of heart disease.

Wheat does not have this beneficial property as the grain has low levels of beta-glucan with a slightly different structure making it insoluble.

Cholesterol and high blood pressure are the two main causes of coronary vascular disease CVD (heart disease and strokes) the biggest cause of death in the western world. Approximately one third of US adults have high cholesterol, causing 800,000 deaths per year and costing more than US$300 billion per year in direct medical costs alone in 2011. One hundred thousand of these deaths are preventable with treatment and changes in diet.

Worldwide production of wheat is predicted to be 723 million tonnes in 2015, five times more than barley and 25 times that of oats – the two other cereals that contain significant amounts of beta-glucan.

### Uncovering the secret life of beta-glucan

To lower cholesterol reabsorption in the gut, beta-glucan needs to be both soluble and viscous and these properties are related to the beta-glucan structure. We wanted to understand how beta-glucans with different structures are synthesised and use this knowledge to make wheat with cholesterol lowering properties.

Beta-glucan is made by an enzyme that sits in the membrane at the surface of the plant cell. This enzyme links activated glucose sugars from within the cell and extrudes the growing beta-glucan chain through a pore in the membrane into the cell wall surrounding the cell.

In beta-glucan the glucose molecules are linked together by a mixture of ß1-3 and ß1-4 bonds, shown as red and black hexagons respectively in Figure 1. The ratio and arrangement of these bonds differs between cereals and this affects the solubility of the beta-glucan.

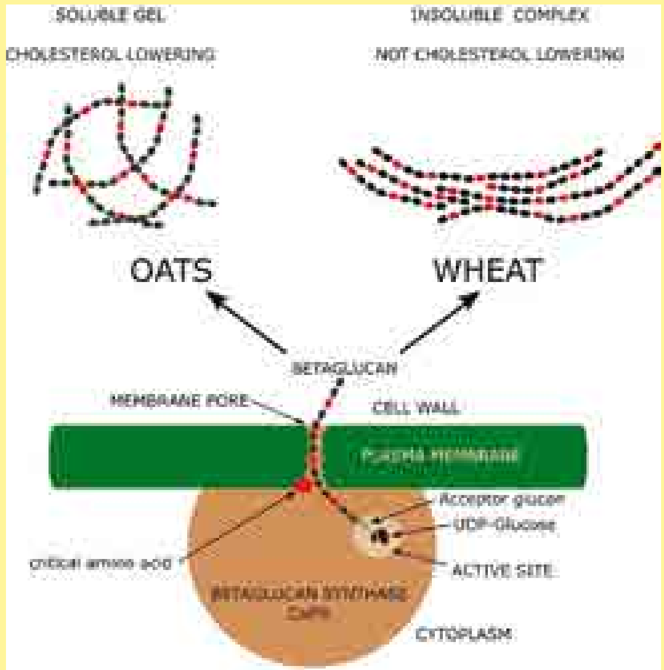
We examined what controls beta-glucan structure by expressing the beta-glucan synthase gene (also known as CslF6) from each of the different cereals (wheat, barley, Brachypodium (a model plant), oat, rice, maize and sorghum) in the leaves of tobacco, a plant which does not contain any beta-glucan.

## What we found

By examining the structure of beta-glucan produced in the tobacco leaf, the cereals could be grouped into two classes; one including oats and the other including wheat.

By mixing and matching bits of the CslF6 protein from each of the two groups, we identified the region of the beta-glucan synthase that controls the structure.

**FIGURE 1: A single amino acid difference at the base of the membrane pore controls the beta-glucan structure, making it more or less soluble**




We discovered that the shape of the membrane pore through which the beta-glucan exits the cell controls the polymer structure. In fact it is just a single amino acid difference at the base of the membrane pore which controls the beta-glucan structure, making it more or less soluble. We think that this difference in shape changes how the glucan acceptor chain (the end where the next glucose molecule will be added) is presented to the active site altering the frequency of ß1-3 and ß1-4 bond formation and hence overall structure.

*This groundbreaking study was published in Science Advances: Membrane pore architecture of the CslF6 protein controls (1-3,1-4)-ß-glucan structure .*

### First steps to making wheat as healthy as oats

The next steps towards wheat with cholesterol lowering properties are already underway. In a proof of principle experiment, we have taken the oat CslF6 gene and expressed this in the wheat grain showing that we can increase both the amount of beta-glucan and change the structure so that it is as soluble as barley beta-glucan.

We did this in trials using genetically modified plants. We're using them at a small-scale to test what's possible and understand exactly what we need to look for when we get to the next stage which doesn't involve genetic modification.

**A wheat flour with a modified beta glucan structure would deliver significant health benefits.**

The trial wheat plants were grown in a controlled field trial (approved by the Office of the Gene Technology Regulator) to get enough grain to evaluate the suitability for bread-making and potential health benefits such as lowering the level of cholesterol reabsorption.

If this is successful, we plan to use conventional breeding techniques to develop a wheat for public consumption.

As wheat is consumed by a large proportion of the population on a daily basis – and in much greater amounts than barley or oats – wheat grain with high levels of soluble beta-glucan could have high socio-economic impact by bringing heart health benefits to the community.

## Some cholesterol facts

Cholesterol is an essential type of fat that is carried in the blood but too much of it is a risk factor for coronary artery disease. Managing your cholesterol by maintaining a healthy diet and lifestyle can help reduce your cholesterol levels.

### What is cholesterol?

Cholesterol is an essential type of fat that is carried in the blood. All cells in the body need cholesterol for internal and external membranes. It is also needed to produce some hormones and for other functions. Too much cholesterol in the blood can damage your arteries and lead to heart disease.

About three-quarters of the cholesterol in your bodies is made in the liver and the rest may come from the types of fats we eat. Your genes will also partly determine what your blood cholesterol levels are as will your diet and lifestyle.

Cholesterol itself in food has only a very small effect on blood cholesterol. But eating too much saturated fat may lead to excess cholesterol in the blood stream.

### Why is high cholesterol a problem?

High blood cholesterol is one risk factor for coronary artery disease (heart attacks and angina). If your cholesterol level is 6.5 millimoles per litre of your blood or greater your risk of heart disease is about four times greater than that of a person with a cholesterol level of 4 mmol/L. Millimoles per litre is the world standard unit for measuring substances in blood.

Not all people with high cholesterol levels get heart disease.

About 30 per cent of the community will die from heart disease and most of these will be over 65 years old. Heart disease usually takes 60–70 years to develop, but if you discover your cholesterol level is high you should see your doctor within the next two to three months, not necessarily tomorrow.

Other risk factors for heart disease include smoking, high blood pressure, type 2 diabetes and obesity. If you have more risk factors it is even more important to keep blood cholesterol levels in check and seek your doctor's advice.

### Cholesterol – the good and the bad

Cholesterol is carried in the blood stream in particles called lipoproteins. These are named according to how big they are:

- The very large particles are called Very Low Density Lipoproteins (VLDL).
- The intermediate size ones are called Low Density Lipoprotein (LDL) and these particles cause heart disease.
- The smallest particles are called High Density Lipoproteins (HDL) and these particles actually protect against heart disease.

### What to do if your cholesterol level is high

The most effective way to lower your LDL cholesterol is to reduce the amount of saturated fat and follow a healthy diet. You could:

- Limit cakes, biscuits, pastries;
- Choose reduced fat milks;
- Use polyunsaturated or monounsaturated margarine or oils instead of butter;
- Choose lean cuts of meat and remove visible fat;
- Remove fat from chicken;
- Include more fish and beans in your meals; and,
- Lose weight if overweight.

If you make a number of changes to your diet you can expect your cholesterol to fall by 10 per cent. About 15 per cent of people will see no change and another 15 per cent will see changes of 20–30 per cent.

The CSIRO *Healthy Heart Program* has been shown to effectively lower LDL cholesterol levels by 15 per cent and includes comprehensive diet and lifestyle information for heart health.

### How high is high cholesterol?

If your cholesterol level is between 5.5 and 6.5 mmol/L your risk of heart disease is only increased by a small amount. Don't panic but make a few moderate changes to your diet. But if you already have heart disease – or one of your parents developed heart disease at an early age, (less than 55 years of age) – then you need to make bigger changes.

### If your cholesterol level is higher than 6.5

If despite changes to your diet your cholesterol level remains above 6.5 you may need medication, especially if you have the other risk factors mentioned or you have a family history of heart disease – see your doctor. ■

# Making biscuits with ancient grains and seeds

By Sandra Avant, Agricultural Research Service – USDA

## AT A GLANCE

- ARS scientists blended oats with chia seeds and amaranth;
- The oat blends may have benefits to health;
- The scientists used the oat blends to make cookies; and,
- The cookies were acceptable in all aspects.

Technician Diejun Chen (left) and chemist George Inglett inspect sugar cookies they made with amaranth and oat products. (PHOTO: Z. Lewis Liu)

MORE people are becoming aware of the health benefits of ancient grains and seeds, such as amaranth and chia seeds, but incorporating them into one's diet is not always easy. That could change in the near future as USDA Agricultural Research Service (ARS) scientists explore the physical properties of these foods, blending mixtures to make treats like sugar cookies (biscuits) that are tasty and good for your health.

At the ARS National Center for Agricultural Utilization Research (NCAUR) in Peoria, Illinois, scientist George E. Inglett and his assistant Diejun Chen have developed amaranth-oat and chia-oat composites that may be used to create foods with health benefits that include lowering the occurrence of heart problems, diabetes, and obesity.

Amaranth flour contains lysine, an essential amino acid, and oats contain beta-glucan, known for lowering blood cholesterol. The researchers blended the two ingredients to make nutritious, gluten-free sugar cookies.

The team compared the amaranth-oat composite cookies and doughs with those made with amaranth or wheat flour alone. Amaranth and its composites had improved water-holding capacities compared to wheat flour. Differences were found in the hardness and shape of doughs and cookies. There were no significant differences in colour and flavor among all cookies.

"Our amaranth-oat cookies were acceptable in all aspects. They had improved nutritional value and physical properties along with gluten-free uniqueness," says George, who works in NCAUR's Functional Foods Research Unit.

Amaranth seeds (left), amaranth flour (right), above the final product – amaranth cookies. (PHOTO: Diejun Chen)

The same can be said for cookies made from the chia-oat composites. Scientists dry-blended Nutrim (a commercial product developed by George that is made from barley or oats), oat bran concentrate, and whole wheat flour with finely ground chia to come up with the powdery mixture.

"Whole chia seeds are not easily absorbed in our systems because of their hard outer coats, but they are pretty good when ground in with other components," George says. "Chia seeds have some very interesting compositions – high oil and rich in polyunsaturated fatty acids, particularly omega 3, that help lower blood cholesterol and prevent coronary heart disease."

In addition to Nutrim, George also developed Oatrim, used as a fat replacement in baked foods; Z-Trim, a zero-calorie insoluble fibre gel that is prepared from high-fibre agricultural products like corn and oat hulls; and Calorie ControlTrim, which contains 20 to 50 per cent beta-glucan.

In recent studies, George found that the amaranth-oat and chia-oat composites have excellent physical properties, which contribute to improved cookie texture, and their nutritional qualities may be valuable in healthy foods.

"Oats are good for you, but we don't get enough. I try to make oats more palatable and available not only for breakfast, but also for lunch and dinner," George says. "That's what my research has been all about over the years – making nutritious food to promote better health." ■

Whole chia seeds. ARS scientists used ground chia seeds as an ingredient in their nutritious cookies. (PHOTO: Al Probyn)

# Tractors at war

By Ian M. Johnston

**Fliegeroffizier (Flying Officer) Walther Meyer gratefully banked the Messerschmitt 109 and pointed its sharp nose south. The squadron of Heinkel 111s, each weighted down with 5000 kilograms of hideous incendiary bombs, would now have to continue on the final leg to Coventry, without the comforting presence of the five fighter escorts.**

**The 109s were handicapped by a limiting 560 kilometre range and having just passed over the landmark village of Chipping Norton, the pilots knew it was time to turn for home.**

The Fliegstaffelfuhrer (Squadron Leader) insisted that returning Messerschmitt 109s spread out, as they winged their way home over the English Southern Counties and seek out targets of opportunity, including RAF bases, trains, military convoys, industrial plants and coastal shipping.

Having surprisingly encountered no opposition thus far from Spitfires or Hurricanes, Walther Meyer was conscious that his one 20 mm canon and two 7.9 mm machine guns remained fully loaded. He was also aware his Fliegstaffelfuhrer directed harsh words towards any 109 pilot who returned with unspent ammunition.

Accordingly, Meyer throttled back the big 1800 hp Daimler Benz 605D inline engine and descended to 600 metres. Avoiding the anti-aircraft defences surrounding the London area, he weaved his way east of Tunbridge Wells, hoping to spot a target prior to crossing the Kent coast near Dungeness.

And there it was! A bright orange Fordson tractor, standing

A sleek but lethal Messerschmitt 109 flying over southern England.

out in clear contrast to the chocolate coloured ploughed field in which it was working.

Meyer kicked the rudder bar and pushed the control column forward, at the same time thrusting the throttle into the wide open position. The unfortunate tractor driver remained totally unaware of the death swooping down upon him. Assailed by a fusillade of white hot bullets and cannon shells, within seconds there remained only a pyre of the smouldering remains of the Fordson and its operator.

As he zoomed over an approaching high ground, Fliegeroffizier Walther Meyer could not believe his luck! Dead ahead was yet another orange Fordson. Within half a minute, a column of smoke marked another 'win' for the laughing Meyer as he urged his Messerschmitt 109 across The Channel in the direction of home. Not only two kills to his credit, but not a Spitfire or Hurricane in sight! And surely only the Brits would be stupid enough to have bright orange tractors in wartime!

## The Fordson

Henry Ford introduced his Fordson Model F in 1917, designed by Bulgarian immigrant Eugene Farkas. Unlike nearly all other tractors of the era, the Model F was a frame-less unit construction. The engine block, gear box and rear differential were joined rigidly together, thus creating an immensely strong unit, which was not subjected to the torsional flexing of chassis type tractors.

It is sufficient to state that the 20 hp tractor performed 'adequately.' But there were two reasons why, by the mid 1920s, the Fordson F had achieved the title of the world's top selling tractor.

Firstly, it sold for around half the price of similarly powered tractors.

Secondly, it was produced in such vast numbers that they were readily available in most farming areas around the world. By 1923 production topped 100,000 per annum. Indeed the British government placed an order for 6000 units and a further 26000 were exported to The Soviet Union.

In a surprise move, in 1928–29 production of Fordson tractors was transferred from the US to Cork in Ireland and then to Dagenham in England. The Model F was upgraded, but in actual fact little changed, to become the 24 hp Model N. The solemn grey colour was changed to a more attractive blue with either red or orange wheels.

A 1941 Fordson in its wartime dull green.

At 143 metres in length, (the length of 1.5 football fields), unlike the heavier steel framed Zeppelins, the Lanz-Schutte airship featured a skeleton framework constructed of laminated wood.

By 1937 Fordson sales entered a period of decline. International Harvester, Massey Harris, Oliver and others were offering better and more modern tractors. A concerned Fordson marketing team decided that a lustrous new colour scheme would likely give a boost to sales. Bright orange was selected!

It is doubtful if this resulted in increased sales, except to the British government, which in 1939 placed an order for 3000 of the orange tractors, in order to bolster the war time 'Ploughing Up Campaign'. This was aimed at increasing farm output, necessary to counter the prevailing wartime food shortages.

By the following year, particularly in the south of England, the farming landscape was significantly embellished by hundreds of gaily coloured Fordson Model N tractors. This unfortunately coincided with the arrival of swastika emblazoned Luftwaffe Heinkels, Dorniers and Junkers and their marauding Messerschmitt escorts.

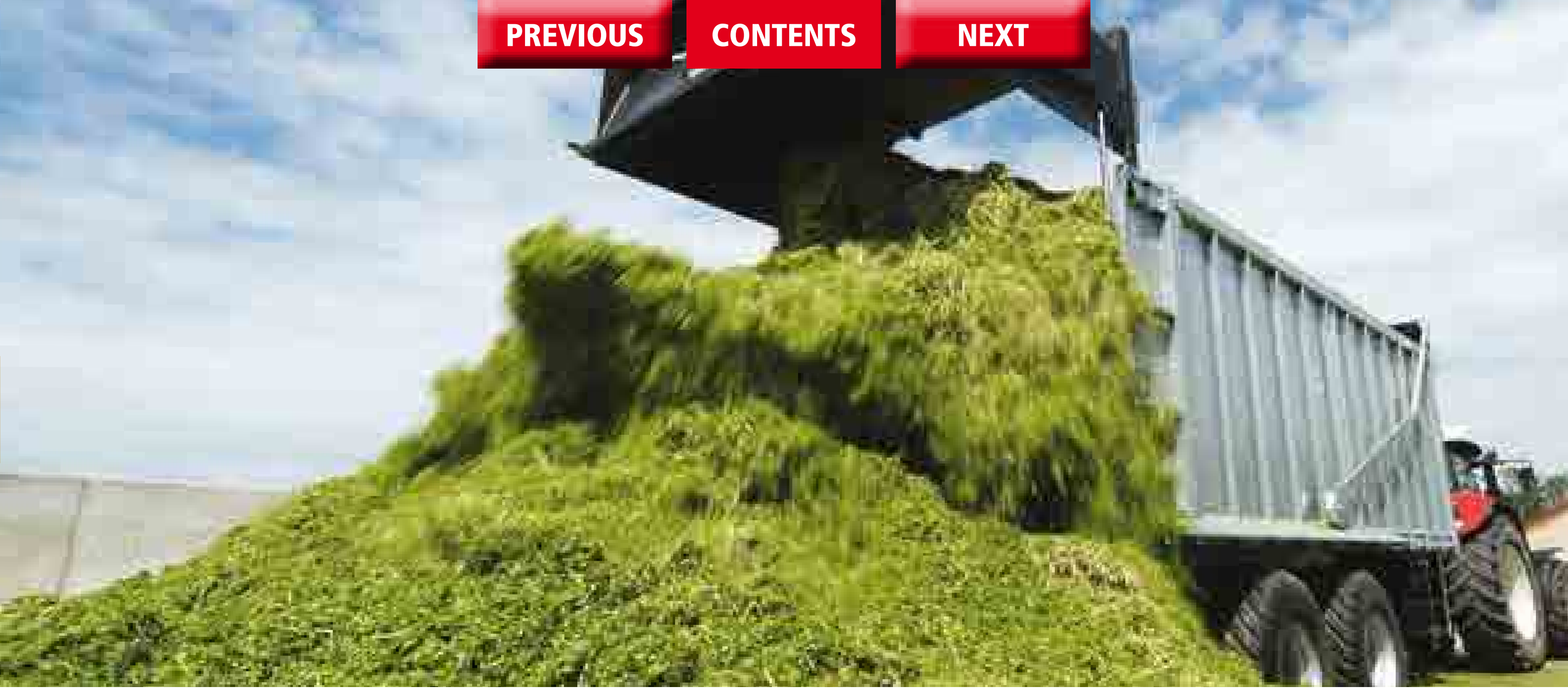
It became a regular occurrence for these innocuous and utterly defenceless tractors and their unsuspecting operators to be blown to smithereens by the German fighter aircraft. Accordingly, His Majesty's War Office held a special meeting decreeing that henceforth, during the wartime emergency, all Fordson tractors would be painted a dull dark green in order they blend in with the rural landscape.

As a result, the mortality rate of British tractor drivers went into a steep decline.

## World War I and Heinrich Lanz

The giant German tractor and farm machinery manufacturer Heinrich Lanz A.G., experienced its first association with military affairs during the latter years of World War I. This was the era in

A Lanz-Schutte airship under construction at Mannheim.




Fliegl

which Count Ferdinand von Zeppelin's airships were converted into bomb carrying flying machines, capable of transporting to, and dropping bombs on, any European capital city.

While historians generally refer to these airships as 'Zeppelins', it is often forgotten (or indeed unknown) that the Mannheim firms of Lanz and Schutte created a partnership to design and manufacture an alternative airship, which proved to be considerably technically more advanced than the Zeppelins.

Unlike the rigid canvass enshrouded metal outer frame of the Zeppelins, which encased the giant hydrogen gas bags, the Lanz-Schutte used an innovative design of laminated timber framework. The lighter material resulted in a much increased carrying capacity. Accordingly, the 143 metre long Lanz-Schutte had a gas capacity in excess of 26,000 cubic metres which enabled a lifting capacity of 8000 kilograms.

Three crew-carrying gondolas were strung below the cigar shaped frame, each supporting a Maybach 240 hp engine with a pusher propeller, providing a cruising speed of 90 km per hour at around 2500 metres.

## World War II and Lanz Bulldogs

By the outbreak of World War II in 1939, Lanz Bulldog tractors were sales leaders in Germany and highly respected around the world (including Australia) for their simplicity of design and dependability. The single cylinder two-stroke engine featured only five moving parts and could be fuelled with low grade and inexpensive naphtha or crude oil.

Owing to the low compression ratio of five to one, it was necessary to pre-heat the hot bulb region of the combustion chamber with a blow lamp, in order for the engine to commence firing.


A Wehrmacht Panzer Tiger pictured in Russia, during the Eastern Front campaign.

This perhaps tedious feature was to prove a godsend for the Third Reich forces during the calamitous Eastern Front campaign, which endured from June 1941 until May 1945, involving central and northern Europe and in later stages the Balkans and Germany.

Basically, when Hitler's Luftwaffe failed to overwhelm Great



## IAN'S CLASSIC TRACTOR QUIZ

The quiz is designed for those who have an interest in tractor history. Some of the questions are dead easy, others are stinkers! But remember it is only a frivolous fun thing, and you are invited to give it your best shot.
Good luck – *Ian M Johnston.*

1. Which one of these single cylinder two-stroke tractor engines was NOT a semi diesel —
***Field Marshall, McDonald Imperial or KL Bulldog?***
2. Australian made Jelbart tractors were manufactured at —
***Bendigo, Ballarat or Benalla?***
3. The Canadian Cockshutt 90 was infact a rebadged —
***Allis Chalmers, Oliver or Case?***
4. The 50 hp diesel powered Sift imported into Australia from Europe during the late 1940s and early 1950s was manufactured in —
***Italy, Germany or France?***
5. The Ansaldo TF70 crawler tractor was powered by a four cylinder diesel —
***Fiat, Landini or Alfa Romeo engine?***
6. The 1913 three wheeled Case was the model —
***1020, 12-25 or 18-32?***
7. Harry Ferguson attached a plough to which make of car to test his revolutionary mounted implement theory —
***Rolls Royce, Ford Model T or Humber?***
8. A four wheel drive industrial loader of the 1960s known as The Crab was manufactured by which Australian company —
***Conquip, Pacific Ace or Cranvel?***
9. The GM 270D engine in the Chamberlain Super 90 was —
***naturally aspirated, turbo charged or supercharged?***
10. In 1929 the Oliver Corporation purchased which opposition tractor company —
***Minneapolis Moline, Hart Parr or Holt?***

See answers on page 56.

Britain during the Battle of Britain (and this when Britain stood alone as America had not yet entered the conflict), he turned his military might in the direction of Moscow, believing The Soviet Union to be a soft target. In this he was to be proved horrendously wrong!

The battles on The Eastern Front between the Allied forces and the German war machine constituted the largest military confrontations in history. An estimated 30 million lives were lost, many of them civilians.

Appalling conditions were experienced during the long winter months, with temperatures dropping to minus 50°C. In addition to the legions of Wehrmacht (Germany army) personnel who froze to death, many being equipped with only tropical uniforms, machinery could also freeze solid.

For example, crews of the fearsome 62 tonne Tiger Panzers (tanks), with their devastating 88 mm guns, were obliged to keep the big 690 hp Maybach engines operating 24 hours a day, or else they froze rock solid.

Similarly, owing to an acute petrol shortage, which determined that petrol powered Wehrmacht trucks could not be left idling during the night, the drivers were required to maintain a smouldering charcoal fire positioned immediately below their vehicle's engine! On the spot execution was the penalty for allowing the fire to go out or should the truck catch alight!

Lanz Bulldog tractors, which could always be started owing to the blow lamp pre-heating arrangement, were perhaps the only engines that did not succumb to the freezing conditions. They were put to a multitude of tasks during the Eastern Front campaign, and were credited with being responsible for the Luftwaffe fighter aircraft being able to continue to operate from their mid-winter Russian located air bases.

**Pictured is a Lanz Bulldog crawler tractor, deployed by the Luftwaffe, dragging a Messerschmitt 110 through soft mud, during the Eastern Front campaign.**

The aircraft (including twin engined Messerschmitt 110s, Junker JU87 Stuka dive bombers, Focke-wulf 190 ground attack fighters and the high wing Henschel Hs 126s,) were cosseted in heated temporary canvas hangers when not operational. Lanz Bulldogs were used to clear the snow on the take-off runways and pull the aircraft from their hangers.

Although plagued with aviation fuel shortages and being subjected to the daunting task of engaging with the much superior Soviet Lavochkin, Yakovlev and Polikarpov fighters, the German aircraft put up a strong resistance until being finally virtually driven from the Soviet dominated skies.

The Lanz Bulldogs were largely destroyed by the advancing Soviets or abandoned by the fuel starved retreating Wehrmacht. ■

# Growers urged to weigh up back-to-back chickpea risks

THE Grains Research and Development Corporation (GRDC) is urging growers to resist the temptation to plant back-to-back chickpea crops this winter to capitalise on a bullish chickpea market.

Attractive new crop chickpea prices have left some growers weighing up whether to run the risk of disease issues or adhere to the industry's best practice management recommendation of a one-in-four year rotation.

New South Wales Department of Primary Industries (NSW DPI) senior plant pathologist Dr Kevin Moore said a back-to-back chickpea plant was risky, warning that 100 per cent crop losses could occur if conditions favoured the development of ascochyta blight, phytophthora root rot and sclerotinia rot.

"Even if there was no sign of these diseases in the 2015 crop it is not safe to plant chickpea on chickpea in 2016. There have been several significant cases in recent years where severe outbreaks of disease occurred in paddocks where it appeared safe to plant," Kevin said.

## Long term consequences

"There are also longer term consequences, particularly for diseases like sclerotinia that have a wide host range.

"The survival structures, sclerotia, remain viable in the soil for many years and could potentially affect many crops including faba bean, canola, lupin, field pea and cotton."



NSW-DPI senior plant pathologist Dr Kevin Moore says large scale crop losses could occur this year if conditions favoured the development of diseases like ascochyta blight, phytophthora root rot and sclerotinia rot.

If serious disease outbreaks were to occur, they would harbour costly and long term implications for the entire grains industry according to Kevin.

"The first implication is the increased risk of the pathogen becoming more virulent and aggressive," he said.

"Secondly, it places increased pressure on the resistance genes in new varieties as crops are subject to earlier infection and potentially more disease cycles within a season; and thirdly, we could see an increased risk of the pathogen developing resistance to fungicide."

## Risks outweigh gains

"The resounding advice is that planting chickpea on chickpea is far too risky and the risks to the grower and the industry far outweigh any potential gains."

Kevin said seed treatments and fallow cultivation would not reduce the risks associated with back to back planting and called on growers to follow current best practice recommendations for disease management in chickpea.

These include maintaining a one-in-four year rotation, avoid planting next to last year's chickpea stubble if possible, ensure all planting seed is pickled, and follow the recommended in-crop ascochyta fungicide strategy for the sown variety.

**For more information visit the GRDC website www.grdc.com.au** ■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# Feathertop Rhodes grass is on the move and is glyphosate resistant

FOUR Australian populations of the increasingly widespread annual sub-tropical weed feathertop Rhodes grass (*Chloris virgata*) have been confirmed resistant to the key herbicide glyphosate.

Feathertop Rhodes grass is yet another species that has increased its abundance during the past 10 years largely due to widespread adoption of no-till cropping and the shift to glyphosate-based weed control on road verges.

"We have now confirmed that two populations from cropping land in New South Wales and Queensland and two from roadsides in South Australia are not controlled with glyphosate at the seedling stage and therefore are classified as resistant," said Dr Chris Preston, chair of the Australian Glyphosate Sustainability Working Group (AGSWG).

"Glyphosate is normally effective on actively growing seedlings, however, once feathertop Rhodes grass begins to tiller it is tolerant of very high rates. Again this is another unwanted world first for Australia," said Chris.

Whilst the weed is not listed on any glyphosate herbicide labels, glyphosate has been widely used in Queensland and northern NSW to control seedlings.

Feathertop Rhodes grass has been found across Australia for decades as a weed of roadsides, fence lines and unmanaged land, especially in summer rainfall areas and irrigated agriculture. During the last 15 years it has become a major cropping weed in Queensland and northern NSW as well as horticultural plantings such as vineyards. It is also dominating many roadsides across southern Australia.

The success of feathertop Rhodes grass is due to the rapid production of large numbers of seed that are easily shed from the heads. Seed germinates if left on the soil surface, with sufficient moisture and temperatures above 25°C. Seed banks appear to be short-lived at around 12 months and burial of seed at any depth prevents germination.

Management strategies need to involve a range of tactics aimed at stopping the production of any fertile seed.

"This poses significant challenges on roadsides where most road managers have opted for glyphosate as the main strategy," stated Chris. "A shift to grass selective Group A herbicides without a robust second 'knock' will lead to the rapid development of Group A resistance in this species."

All infestations must be mapped and targeted to prevent spread. Avoid road works and slashing plants with seed heads. Do not move soil likely to be contaminated with seed to 'clean' areas.

**The AGSWG is supported by the Grains Research and Development Corporation (GRDC) and key R&D-based crop protection companies with an interest in the sustainability of glyphosate.**

**The group's website has a range of information about glyphosate resistance including a register of glyphosate resistant weed populations and guides and links for management of glyphosate resistance in different crops and management situations.**
**Go to www.glyphosateresistance.org.au for more information.**

**For information on herbicide sustainability visit the WeedSmart information hub at www.weedsmart.org.au** ■

**Feathertop Rhodes grass head showing shedding seed.**
**(PHOTO: Agronomo)**

**Large infestation of feathertop Rhodes grass in southern Western Australia where it is spreading with summer rains.**
**(PHOTO: Agronomo)**

NORTHERN FOCUS
COVERING NORTHERN NSW AND QUEENSLAND

# Chickpeas – what we learnt in 2015 and recommendations for 2016

By Kevin Moore, Leigh Jenkins, Paul Nash, Gail Chiplin and Sean Bithell – Department of Primary Industries, NSW

## AT A GLANCE…

- Plant chickpea seed of known identity and purity and of high quality that has been properly treated with a registered seed dressing.
- Localities where Ascochyta was found on any variety in 2015 are considered high risk for 2016 chickpea crops and growers are advised to apply a preventative fungicide before the first post-emergent rain event to all varieties including PBA HatTrick.
- Mild temperatures, long cloudy periods and frequent rainfall events during June–July across the Northern region, as occurred in 2015, are ideal for early season outbreaks of Ascochyta blight in chickpea crops.
- In wet seasons the management of Ascochyta can be hindered by getting ground rigs into wet paddocks as well as a shortage of fungicides.
- Follow the disease management recommendations in this article – as well as the GRDC and Pulse Australia resources – they will maximise your chance of a profitable chickpea crop in 2016.

THE 2015 northern NSW/southern Queensland chickpea season – with unprecedented high prices (peaking at $900 in June) – led to a record planting of chickpeas in the region. Planting conditions were generally favourable (Table 1) and chickpeas were in the ground relatively early.

**Strong prices may well see a record area of chickpeas this season. The right disease management will be needed to capitalise on this opportunity.** (PHOTO: SARDI)

Most areas then had good rain during June and July (Table 2). With the exception of the Darling Downs and western areas, these conditions, together with early sowing resulted in high biomass crops which used a lot of water.

Cold, dry weather from late August to late September led to flower and pod abortion. This was not helped by considerable temperature fluctuations in the last 10–14 days of September (up to 20°C in a 24 hour period).

**TABLE 1: January–May 2015 rain (mm) at selected locations in NSW/Queensland**

| Location | Jan | Feb | Mar | Apr | May |
|---|---|---|---|---|---|
| Roma | 86 | 31 | 33 | 46 | 12 |
| Dalby | 107 | 49 | 13 | 11 | 86 |
| Dubbo | 131 | 32 | 8 | 82 | 48 |
| Gilgandra | 103 | 21 | 3 | 99 | 73 |
| Trangie | 59 | 1 | 11 | 114 | 48 |
| Nyngan | 91 | 5 | 13 | 44 | 44 |
| Coonamble | 74 | 11 | 6 | 76 | 51 |
| Walgett | 34 | 0 | 6 | 24 | 30 |
| Moree | 105 | 4 | 60 | 63 | 33 |
| Tamworth | 90 | 23 | 52 | 86 | 38 |

**TABLE 2: June–November 2015 rain (mm) at selected locations in NSW/Queensland**

| Location | Jun | Jul | Aug | Sep | Oct | Nov |
|---|---|---|---|---|---|---|
| Roma | 64 | 12 | 24 | 16 | 16 | 41 |
| Dalby | 10 | 18 | 24 | 15 | 47 | 9 |
| Dubbo | 72 | 60 | 39 | 8 | 46 | 67 |
| Gilgandra | 87 | 59 | 31 | 1 | 32 | 92 |
| Trangie | 44 | 44 | 33 | 3 | 28 | 99 |
| Nyngan | 51 | 35 | 29 | 7 | 13 | 70 |
| Coonamble | 39 | 27 | 13 | 4 | 29 | 35 |
| Walgett | 58 | 44 | 27 | 1 | 34 | 72 |
| Moree | 62 | 36 | 11 | 4 | 10 | 83 |
| Tamworth | 109 | 34 | 54 | 24 | 50 | 71 |

Hot, dry conditions in early October put crops under further stress (as most had run out of water).

Thus, in many parts of northern NSW, seasonal conditions conspired to produce big canopies that ran out of water during the major pod filling period. Coupled with frosts, and low and fluctuating temperatures, this resulted in missing pods, ghost pods or single-seed pods.

Nevertheless, in NSW, yields east of the Castlereagh and Newell highways were generally good with the better crops going 2.5–3.0 tonnes per hectare. But farmers west of these highways were disappointed with some crops yielding less than 0.2 tonnes per hectare.

In Queensland, some crops on the Darling Downs planted on wide rows went better than 3.0 tonnes per hectare with at least one Kyabra crop going 3.6 tonnes per hectare. The Downs crops were sown on a full profile but with in-crop rainfall well below average, they did not have a lot of biomass.

This, coupled with wide rows which allowed the soil to warm up, is believed to account for the large yield differences between crops at say Dalby and those at Moree.

## Chickpea diseases in 2015

In 2015, Ascochyta blight, AB (*Phoma rabiei* formerly called *Ascochyta rabiei*) was detected in 60 crops. High chickpea prices tempted some growers to break rules – such as plant back to back chickpeas – and they paid the price in terms of higher AB infection and AB management costs.

Some growers reported more AB in PBA HatTrick than they ever saw in Jimbour, but many of these crops had been inundated in June–July and we know that AB resistance of waterlogged chickpeas is compromised. Further, the genetic purity of the variety could not be determined.

But generally, good management and dry conditions through August–October kept AB under control and no major yield losses were reported.

Phytophthora root rot, PRR (*Phytophthora medicaginis*, 23 cases) caused light to moderate losses but only in paddocks with a history of medics or where the susceptible variety PBA Boundary was planted.

The mild wet winter also favoured Sclerotinia (24 cases) especially in paddocks with a canola history, with both basal and aerial infections detected. Where canola was involved, the species was always *S. sclerotiorum*.

One crop in the wetter areas east of Narrabri had aerial infection from ascospores of *S. minor* instead of the typical infection of roots and stem base by mycelia from sclerotia.

### First infection from windborne spores

This was the first record in this region for infection from windborne ascospores from sclerotia (due to carpogenic germination of sclerotia) leading to infection of chickpea by *S. minor*. If such windborne infection is common, greater *S. minor* infection may result.

Botrytis grey mould, BGM (*Botrytis cinerea*) threatened to be a problem in high biomass crops and some of these were sprayed with carbendazim in early spring. This together with the hot dry finish, diminished the risk of BGM and no damage was reported.

Across the region, viruses were uncommon only reaching damaging levels in crops with poor, patchy stands (often the result of early season waterlogging) or where weeds had not been controlled.

Herbicide injury (Groups B, C and I) was detected in most crops during June–July inspections including one striking example of damage predisposing a crop of PBA HatTrick at Billa Billa to PRR. Overall, herbicides caused no serious yield loss.

**TABLE 3: Chickpea seed treatments**

| Active ingredient | Example product | Rate | Target disease |
|---|---|---|---|
| Thiabendazole 200 g/L+ thiram 360 g/L | P-Pickel T | 200 mL/ 100 kg seed | Seed-borne Ascochyta, Botrytis, Damping off, Fusarium |
| Thiram 600 g/L | Thiram 600 | 200 mL/ 100 kg seed | Seed-borne Botrytis and Ascochyta, Damping off |
| Thiram 800 g/kg | Thiragranz | 150 g/ 100 kg seed | Seed-borne Botrytis and Ascochyta, Damping off |
| Metalaxyl 350 g/L | Apron X 350 ES | 75 mL/ 100 kg seed | Phytophthora root rot |

## Recommendations for 2016

### Seed treatment and seed purity

Seed borne Botrytis, seed borne Ascochyta and several soil borne fungi can cause pre and post-emergence seedling death.

Irrespective of source of seed and year of production all chickpea planting seed should be treated with a registered seed dressing (Table 3).

Proper coverage of the seed with an adequate rate of product is essential. Be confident of the identity and purity of your planting seed. If unsure, acquire certified seed from a reputable seed merchant.

### Ascochyta blight

The following strategy should reduce losses from Ascochyta in 2016:

- In areas where AB was detected in 2015, spray all varieties, including PBA HatTrick and PBA Boundary with a registered Ascochyta fungicide prior to the first rain event after crop emergence, three weeks after emergence, or at the three branch stage of crop development, whichever occurs first.
- In areas where AB was NOT detected in 2015, spray all varieties with AB resistance lower than PBA HatTrick with a registered Ascochyta fungicide prior to the first rain event after crop emergence, three weeks after emergence, or at the three branch stage of crop development, whichever occurs first.
- Two to three weeks after each rain event, monitor all crops irrespective of variety and spray if Ascochyta is detected in the crop or is found in the district on any variety.
- Ground application of fungicides is preferred. Select a nozzle such as a DG TwinJet or Turbo TwinJet that will produce no smaller than medium droplets (ASAE) and deliver the equivalent of 80–100 litres water/hectare at the desired speed.
- Where aerial application is the only option (such as, wet weather delays) ensure the aircraft is set up properly and that contractors have had their spray patterns tested.

### Botrytis grey mould, BGM

In areas outside Central Queensland, spraying for BGM is not needed in most years. But if conditions favour the disease it will develop even though BGM was not a problem in 2015. Thus, in situations favourable to the disease (high biomass, average daily temperature 15°C or higher, overhead irrigation in spring), a preventative spray of a registered fungicide before canopy closure – followed by another application two weeks later will assist in minimising BGM development in most years.

If BGM is detected in a district or in an individual crop particularly during flowering or pod fill, a fungicide spray should be applied before the next rain event.

None of the fungicides currently registered or under permit for the management of BGM on chickpea have eradicant activity, so their application will not eradicate established infections. Consequently, timely and thorough applications are critical.

### Phytophthora root rot

Phytophthora root rot is a soil and water-borne disease – the inoculum can become established in some paddocks. Alternative Phytophthora hosts such as pasture legumes – particularly medics and lucerne – must be managed to provide a clean break between chickpea crops. Damage is greatest in seasons with above average rainfall but only a single saturating rain event is needed for infection.

Avoid high-risk paddocks such as those with a history of Phytophthora in chickpea, water logging or pasture legumes, particularly medics and lucerne. If considerations other than Phytophthora warrant sowing in a high-risk paddock, choose PBA HatTrick or Yorker and treat seed with metalaxyl.

Metalaxyl can be applied in the same operation as other seed dressings providing all conditions of permits and labels are met. Metalaxyl only provides protection for about eight weeks; crops can still become infected and die later in the season.

**Further information on chickpea disease management can be found at the GRDC and Pulse Australia websites: www.grdc.com.au and www.pulseaus.com.au**

**This research is made possible by the significant contributions of growers through both trial cooperation, paddocks access and the support of the GRDC. The authors would like to thank them for their continued support.**

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# What's the ideal row spacing and time of sowing for faba bean?

By Rebecca Raymond[3], Kerry McKenzie[1] and Rao Rachaputi[2]

## AT A GLANCE…

- In general, increasing row spacing may decrease yield in faba bean varieties.
- A reduction in yield of faba beans can occur if sown after late April – but with an increase in harvest index.

DESPITE the potential environmental and economic benefits, the adoption of winter pulse crops in the Queensland grains region is around 20 per cent of total cropping area. To increase the share of pulses in the total cropping area, strategies are required to enable growers to more consistently realise the potential productivity and profitability of pulse cultivars in their farming systems.

Chickpea and faba bean make up most of this 20 per cent although the adoption varies depending on the growing region and of course price.

Yield of faba beans ranges from two to four tonnes per hectare but the Pulse Agronomy trials have shown a potential of up to 5.5 tonnes per hectare.

Although the area sown to winter pulses in Queensland has increased over the past three years, there have been many challenges for growers with erratic seasonal conditions and a range of disease pressures on yield and quality. Growers' attitude to pulse crops is also influenced by forecast prices relative to other cropping options, including cotton, and experiences from the previous season.

The area of winter pulses in the region needs to be stabilised and the reliability of achieving seasonal yield potential improved.

The Pulse Agronomy project has consulted widely within the pulse industry to determine the priorities to be investigated throughout the term of the project.

### Faba bean (*Vicia faba*)

Is gaining popularity in the northern grains region thanks to higher prices in recent seasons and improved varieties. Although southern regions dominate the production for Australia; northern NSW and southern Qld are looking more favourably upon faba bean as part of their rotation as a break crop for disease and for its nitrogen fixing ability.

**Faba bean is becoming a more popular winter pulse choice.**

### Focus on faba bean

There have been two seasons of faba bean trials at the Garah site as part of the Northern Pulse Agronomy Project. In 2014 three cultivars – PBA Warda, PBA Nasma and Cairo – were planted at a density of 25 plants per $m^2$ and on varying row spacings (25, 50, 75 and 100 cm). Varieties responded positively to decreasing row spacing. In addition, 2014 (Dalby) showed a linear reduction in yields after the sowing date of April 23.

Winter 2015 saw the inclusion of varied planting densities (5, 10, 20 and 30 plants per $m^2$) across the same four row spacings (25, 50, 75 and 100 cm) looking at two cultivars PBA Warda and PBA Nasma.

A seed size trial was also conducted at a Dalby site which had three different seed sizes of the PBA Nasma (IX220-D) cultivar planted at 75 cm row spacing at four different planting densities.

This trial was designed to determine the effects of seed size on yields and whether it is possible to grow a larger proportion of large seeds from smaller parent seeds as there is potential for issues with the larger faba bean seed blocking air seeders.

Time of sowing trials were also conducted at both Warra and Hermitage Research Station in 2015, each site sowing on three dates starting in April and concluding in late May. The initial plan was to begin these sowing dates in late March but rain forced the delay of sowing at both locations. These trials were at varying targeted plant densities on 75 cm row spacing.

## What we found

### Row spacing effects on faba bean yield

Overall, average yields were obtained at the Garah site and significant effects of the agronomic treatments were obtained. There was deemed to be no significant difference overall between the cultivars PBA Warda and PBA Nasma, but PBA Nasma had an overall higher yield at 3.24 tonnes per hectare over PBA Warda at 2.97 tonnes per hectare (Table 1). These results are consistent with those found in 2014 at the same site.

The narrower row spacings of 0.25 m and 0.5 m have significantly out yielded the wider spacings of 0.75 m and 1.00 m in both 2014 and 2015 (Figures 1 and 2).

Overall, in both years that row spacing and yield have been investigated at Garah, both varieties responded positively to decreasing row spacing.

### Effect of plant population on faba bean yield

In 2015, populations were investigated as an effect on faba bean yield, but no significant differences were found between the

**FIGURE 1: Effect of row spacing on faba bean yield, Garah 2015**

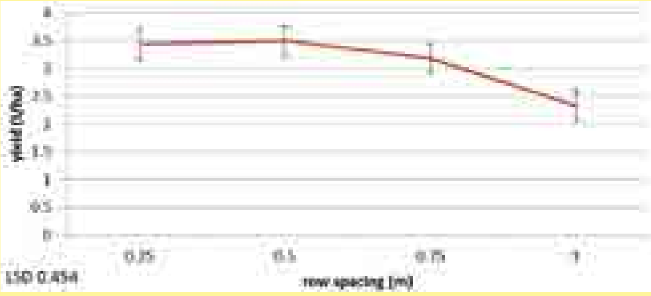
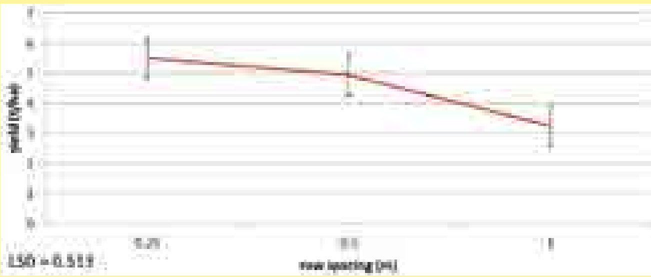



**FIGURE 2: Effect of row spacing on faba bean yield, Garah 2014**




5, 10, 20 and 30 plants per m$^2$. It is thought that this is due to the crop 'hitting a wall' and running out of moisture at grain fill.

When looking at total dry matter (tonnes per hectare) in the same crops, population was different with 5 plants per m$^2$ being significantly lower than the 10, 20 and 30 plants per m$^2$ treatments.

Further analysis of water use needs to be completed. But early suggestions are that the crop has run out of moisture at grain fill and the plots with higher populations have had less moisture available to finish off, and as a result, have not been significantly higher in yield as expected at the higher planting density.

## Effect of time of faba bean sowing on yield, dry matter and harvest index

A time of sowing trial was conducted near Dalby in winter 2014 which showed that there was a linear reduction in faba bean yield post the planting date of April 23 (Figure 4).

This trial was repeated in winter 2015 at the Hermitage Research Station (HRS) near Warwick, and at Warra, Queensland. At both locations there were three sowing dates planted at 75 cm row spacing and on four targeted plant populations 5, 10, 20 and 30 plants per m$^2$. It was anticipated that the sowing dates would be three weeks apart, but due to wet weather it was not possible. The dates used for the trial at each location can be seen in Table 1.

**FIGURE 3: Effect of population on dry matter (t/ha)**

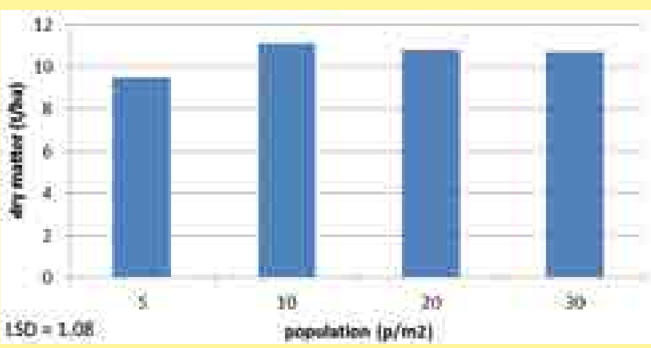



**FIGURE 4: Effect of time of sowing date on faba bean yield, Dalby 2014**

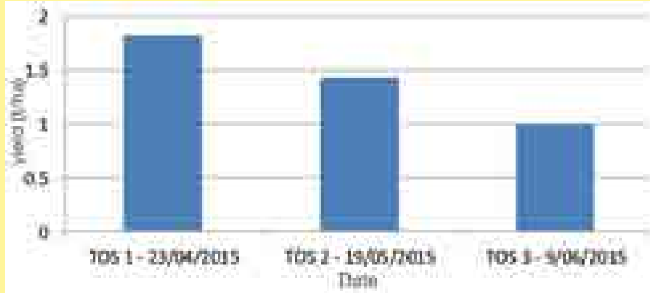



**TABLE 1: Sowing dates at Warra and Hermitage Research Station (HRS)**

| | | | |
|---|---|---|---|
| **HRS 1** | 17/04/2015 | **Warra 1** | 9/04/2015 |
| **HRS 2** | 20/05/2015 | **Warra 2** | 28/04/2015 |
| **HRS 3** | 12/06/2015 | **Warra 3** | 21/05/2015 |

At HRS there was no statistical difference between the yields between the first and second time of sowing, but there was a significant drop in yield of 300 kg from TOS 1 and 500 kg from TOS 2 out to the third sowing date.

A similar result was found at Warra – the first two sowing dates showed nil significant difference as did the difference between the second and third dates – but a marked drop in yield was found between the first and third dates (Table 2).

**TABLE 2: Effect of time of sowing on yield (t/ha), Warra (lsd 0.5) and HRS (lsd 0.36) 2015**

| | TOS 1 | TOS 2 | TOS 3 |
|---|---|---|---|
| Warra | 3.56a | 3.31ab | 2.84b |
| HRS | 3.6a | 3.8a | 3.3b |

From the two years of data it can be concluded that the current suggested sowing time of late April would still be appropriate and that crops planted into May and beyond could expect a linear reduction in yields. Further work could be completed with more emphasis placed on earlier sowing dates to identify if earlier than late April is appropriate.

Results also indicate that total dry matter declines post the first

**FIGURE 5: Effect of time of sowing on total dry matter at HRS and Warra, 2015**

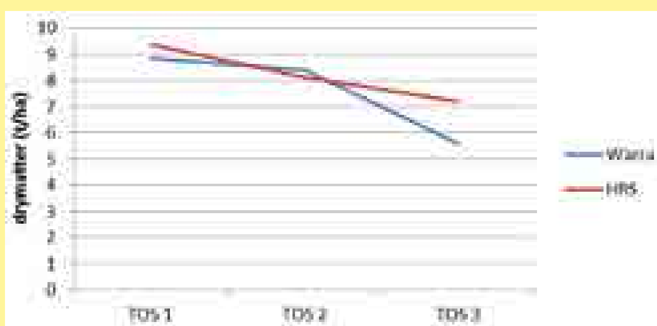


**FIGURE 6: Effect of time of sowing on harvest index, HRS and Warra 2015** (LSD Warra – 0.08, HRS – 0.048)

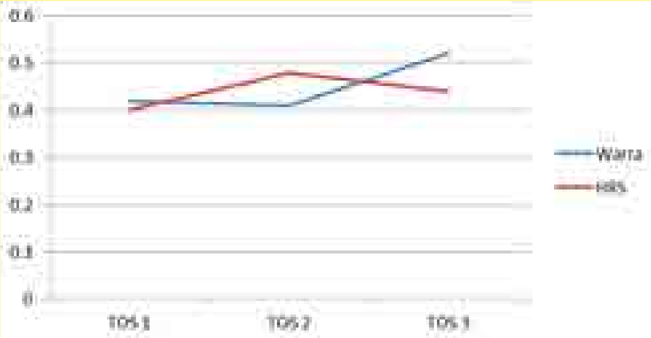



**TABLE 3: Effect of seed size on faba bean yield**

| | Dimensions | Seed weight (g) | |
|---|---|---|---|
| Size 1 (small) | 25/64" | 52.32 | 1.95a |
| Size 2 (medium) | 28/64" | 66.93 | 2.03ab |
| Size 3 (large) | 33/64" | 84.19 | 2.23b |

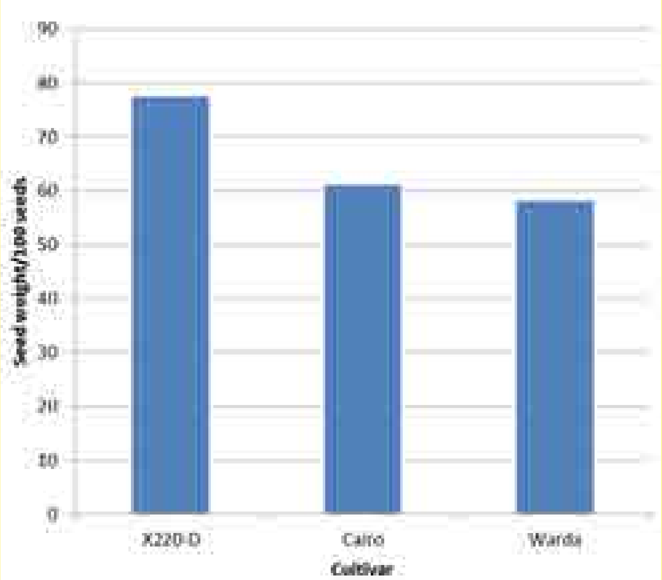
TOS at both locations (Figure 5) – the 2015 season saw crops initially grow a large amount of vegetation on available moisture, but we cannot determine from this trial the reason that TOS 2 and 3 did not follow the same pattern.

The harvest index has increased for TOS 2 and 3 at both locations, but yield is lower (Figure 6). More investigation is needed into crop growth of faba beans to enable us to better understand the crop partitioning and in turn increase yield and harvest index rather than growing large biomass and not being able to convert to yield.

## Effect of seed size

When using PBA Nasma as a cultivar in 2014 trials it was found that the seed size was 25 per cent larger and an average seed weight of 78 g per 100 seeds compared with the 58 g per 100 seeds of PBA Warda (Figure 7). This larger seed size could pose an issue blocking airseeders. As a result of this, a trial was designed to investigate whether planting seed size has an influence on yield and also seed size of the resultant crop.

**FIGURE 7: Faba bean seed weights by cultivar**



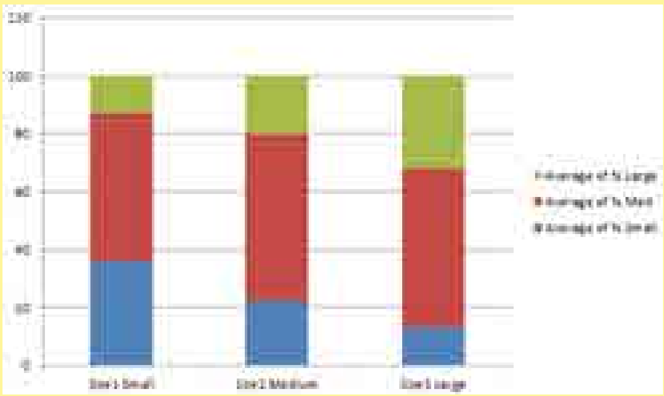

The seed for the trial was graded into three different sizes and planted at four different populations on row spacing of 75 cm. The trial was planted in May due to rainfall, which was later than anticipated, and could have led to a yield reduction.

Table 3 shows that there was a significant difference in the yield achieved between the small and large seed sizes but not between small and large and the medium seed size.

When harvested, each of the three seed size plots were then graded out into the same three sizes – the proportion of each seed size that was taken from each plot can be seen in Figure 8.

Each of the sizes grew a larger proportion of medium seed than the size of its parent seed, but size 1 grew more size 1 than size 3, size 2 grew more size 2 and similar amounts of size 1 and 3 and size 3 grew a larger amount of size 3 than size 1.

**FIGURE 8: Effect of seed size planted on the percentage of seed size produced**



It is not a recommendation to grade out larger sized seed to increase seed numbers for weight.

Marketing factors have not been taken into account in this trial.

## To sum up

When planting faba beans, narrow row spacings (25–50 cm) consistently yield higher than wider row spacings (75 cm and above).

This effect has been seen across two years and differing seasons and environments.

Row spacing has a larger effect on yield than plant population.

Earlier planting of faba beans is best to maximise yields, but later plantings – are after one year of trials – producing lower biomass and as a result, higher harvest index.

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# Drivers of fallow efficiency

By Kirsten Verburg[1] and Jeremy Whish[2], CSIRO

## AT A GLANCE…

- Soil properties (bulk soil and surface conditions) affect fallow efficiency through their effects on the different water balance factors.
- Rainfall patterns affect fallow efficiency as well as the effectiveness of stubble cover to reduce evaporation losses.
- The more limited effect of stubble retention on evaporation does not take away the benefits stubble cover provides in protecting the soil surface, increasing infiltration and reducing runoff and erosion.

PLANT available water (PAW) at sowing will depend on water left behind by a previous crop, rainfall amount during the fallow and its distribution, efficiency of water infiltration (versus runoff), evaporation, water use (transpiration) by weeds, drainage beyond the root zone and in some cases subsurface lateral flow. Fallow efficiency – defined as the proportion of rain falling during the fallow period that becomes PAW – is similarly affected by these water balance factors.

Fallow management of stubble and weeds can change the magnitude of some of these water balance factors. This article looks at how soil properties and rainfall patterns affect evaporation and the effectiveness of stubble cover.

### Impact of soil properties on evaporation

The smaller particle size of clay soils allows them to hold larger quantities of water than sandy soils (such as lower drainage losses), but also causes the pore space (space between particles) to be finer. This reduces the water infiltration rate and can increase runoff losses, particularly in high intensity rainfall events and following prolonged rainfall.

But soil surface conditions can dramatically change this picture – open cracks in shrink–swell soils will aid infiltration, whereas surface sealing will increase runoff.

The higher PAWC of clay soils also means that water from small events is stored close to the soil surface where it will often be lost to evaporation if no follow up rain occurs. In sandy soils the water will infiltrate deeper into the profile.

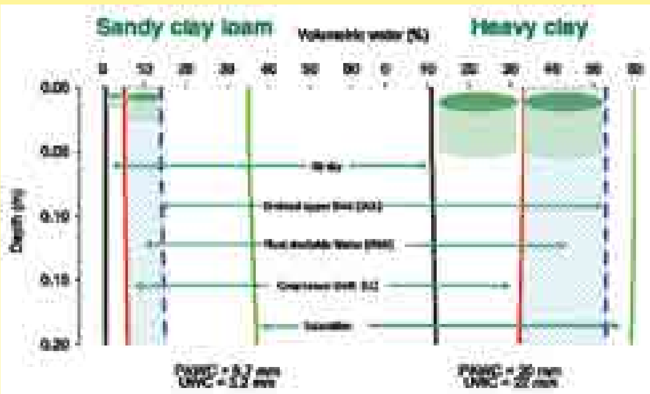
Evaporation can dry the soil to below the crop lower limit in the surface layer. While this is a slow process in clay soils, the amount of rainfall needed to replenish this unavailable 'bucket' following a prolonged dry period will be larger in a clay soil than in a sandy soil.

This is illustrated in Figure 1 where a sandy clay loam soil can hold 11.9 mm of water between the air–dry value and drained upper limit, but with only 8.7 mm available to the plant and an unavailable water capacity (UWC) of 3.2 mm. If evaporation had dried the soil to air dry and we had a 10 mm rainfall event, only 6.8 mm would be available for plant growth.

In contrast the heavy clay soil in Figure 1 holds 42 mm between air dry and drained upper limit of which 20 mm is available for plant growth. In the same scenario as before, if the soil was dry and we had a 10 mm rainfall event there would be no water available for plant growth, unless it want down a deep crack into deeper and less dry soil. Over 22 mm of rain needs to fall to fill the unavailable bucket in the surface of this soil.

Fortunately, the fine structure of the heavy clay soil also means the unavailable bucket will take a long time to dry out, so that on many occasions only the upper layers of the soil will need to be refilled.

**FIGURE 1: Conceptual diagram of the difference in unavailable water bucket size (UWC) in the surface 20 cm of a sandy clay loam and a heavy clay soil**




## Impact of rainfall pattern

The interaction between depth of infiltration and susceptibility to evaporation loss also plays a role in determining the effectiveness with which rainfall is turned into PAW for the subsequent crop.

Unless runoff is an issue, large rainfall events will infiltrate deeper than small events, allowing some of the water to be pushed below the evaporation zone and contribute to PAW at sowing. But single, isolated rainfall events have typically a lower efficiency than more frequent events. When two or more rainfall events occur closely together, the resulting soil water 'pulses' can build on each other (Figure 2).

The amount of water needed to refill the unavailable bucket in the surface layer (following evaporation) is reduced, thereby allowing the water to move deeper into the profile.

The amount of overlap between soil water 'pulses' is affected by a balance between pulse frequency and pulse duration.

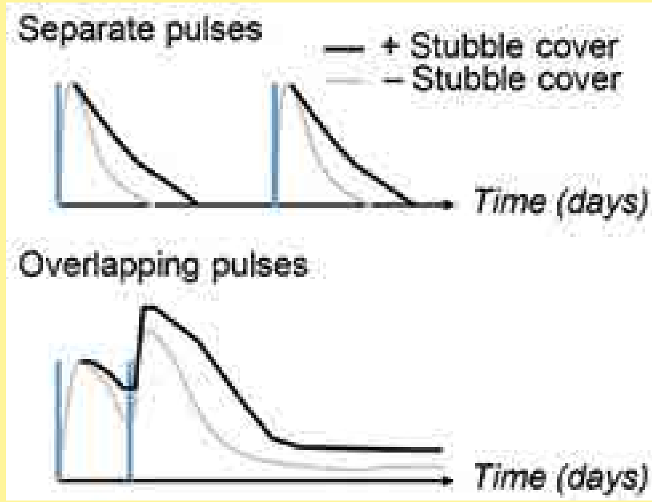
Rainfall frequency is the driver behind pulse frequency, whereas pulse duration is affected by the amount of infiltrated rainfall, evaporative demand, stubble cover and soil type.

The above illustrates why the same amount of rainfall can result in different fallow efficiencies. But surface conditions can complicate the picture. Surface sealing following multiple or prolonged rainfall events can reduce the infiltration rate and increase runoff. Conversely, a single large storm on a dry cracking clay soil can infiltrate deeper via the open cracks.

## Stubble and evaporation losses

Trials have shown how fallow weed control can dramatically reduce transpiration losses and that stubble retention increases infiltration and reduces runoff. But the effect of stubble and stubble management (such as, standing vs. flattened stubble) on reducing evaporation losses has often disappointed people with many trials returning no significant treatment effects.

**FIGURE 2: Rainfall events (vertical blue bars) cause pulses of soil water that last for different amounts of time in the presence (black lines) or absence (grey lines) of stubble. When pulses overlap, more water infiltrates beyond the evaporation zone in the presence of stubble cover and this will increase fallow efficiency.**




(Adapted from Verburg et al. 2010)

The observed limited effectiveness of stubble cover to reduce evaporation losses can be explained using the same concept of soil water pulses.

The high evaporative demand experienced during summer in Australia limits the duration of the soil water pulses. In the case of sparse rainfall events this allows the system with stubble cover to 'catch up', despite the initial reduction in evaporation. Stubble cover slows evaporation for around three weeks following rainfall, but there is no longer term benefit to soil moisture levels.

If the next rainfall event occurs prior to the system catching up, soil water will move deeper in the system with stubble cover and may store (more) water beyond the nominal evaporation zone.

A higher level of stubble cover will prolong the duration of the soil water pulse, increasing the chance of events overlapping and of causing a lasting increase in PAW.

In the event of small, isolated rainfall events, high loads of stubble may be detrimental to overall PAW with the water captured in the stubble layer and prone to evaporation.

As shown in Figure 2, evaporative demand plays a role too. A lower evaporative demand will lengthen the duration of soil water pulses and hence increase the chance of pulses to overlap.

Experiments near Wagga Wagga showed that stubble cover later in autumn and early winter (when evaporative demand was lower and rainfall frequency higher) did cause a significant reduction in evaporation. The reduction was 10–15 mm over an eight week period, following sowing into a stubble load of four tonnes per hectare, while differences over the preceding four months during summer were only 3–4 mm.

**CSIRO Agriculture Canberra[1] and Toowoomba[2]**

**The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the authors would like to thank them for their continued support. The concepts and findings presented in this article were developed as part of GRDC projects CSP00170, CSP00111, CSA00013 and ERM00002.**

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SOUTHERN AUSTRALIA FOCUS

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# Early sown wheat – opportunities and risks

By Brenda Shackley, Christine Zaicou-Kunesch and Jeremy Curry – DAFWA

## AT A GLANCE…

- Current commercial varieties have good potential for yield when sown early but at higher risk of frost and other grain quality issues.

OUR recent research has looked at grain yield and quality responses of long season wheat varieties sown mid-April, compared to the more conventional sowing times. Trials in 2015 have suggested that the highest grain yields are not always achieved at the earliest sowing opportunity and that very early sowing opportunities, pre-Anzac Day, need a more suitable variety for the WA environment.

A series of three trials were located at Dandaragan, Katanning and Gibson. The trials examined 12 wheat and 12 barley varieties at three sowing dates. Wheat varieties included Mace, Magenta, Trojan, Harper, Yitpi, Calingiri, Zen, Bremer, a winter wheat Whistler, newly released Cutlass and two potential mid to long season varieties.

The sowing dates were similar at all three sites with Dandaragan sown April 16, May 7 and May 27; Katanning sown April 15, May 6 and May 27; and, Gibson sown April 16, May 8 and May 27.

These dates are collectively referred to as mid-April, early May and late May.

All trials were sown into canola stubble and the fungicide Prosaro was applied as recommended for controlling powdery mildew and yellow spot/septoria compendium.

Heading and flowering dates were recorded at each location by routinely recording the Zadok score every Monday, Wednesday and Friday.

## What we found

Many areas in the wheatbelt of WA received good levels of summer rain in 2015, including the sites at Dandaragan and Gibson (Table 1). Rainfall continued into April providing the opportunity to sow mid-April into good levels of moisture at Gibson and drying topsoils at Dandaragan and Katanning.

Excellent plant establishment was achieved at Gibson resulting in an average of 173 plants per m² across all sowing times. Dandaragan had a drying topsoil with all sowing resulting in an average establishment of 115 plants per m², while Katanning had some non-wetting and seeding issues resulting in an average of 95 plants per m².

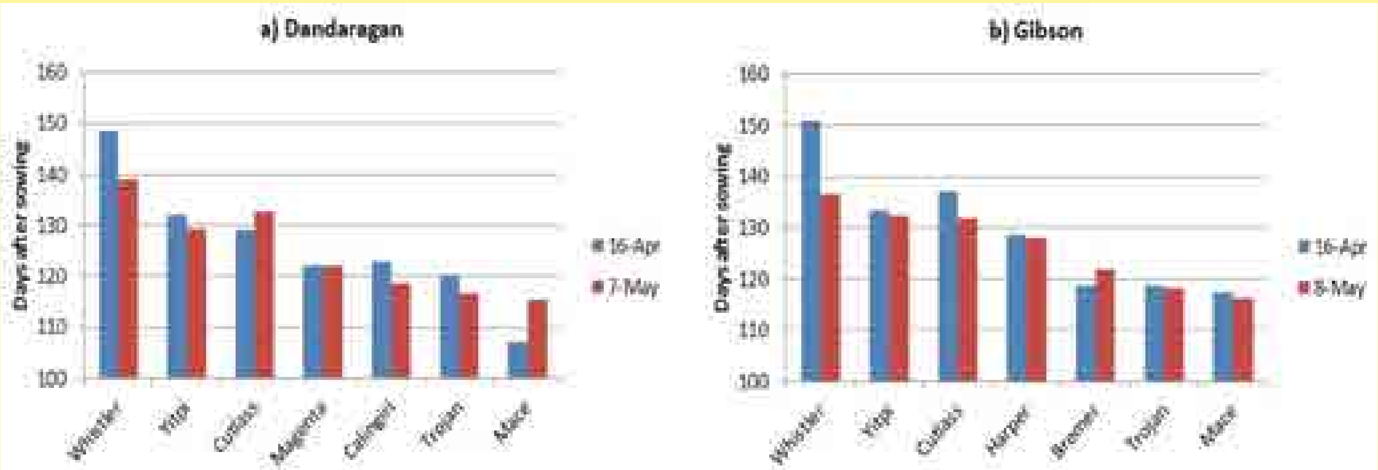
Issues at Katanning led to only 50 per cent of the seed germinating in mid-April while the remainder germinated just prior to the second time of sowing.

Temperatures below 2°C were recorded at Katanning on 26 July, 24 and 25 August, 3, 6, 16 and 20 September and 5 October. Mace sown mid-April had ears emerging by late July

**TABLE 1: Monthly rainfall (mm) recorded at Dandaragan (PPD station), Katanning (DAFWA station) and Gibson in 2015**

| | Jan | Feb | March | April | May | June | July | August | Sept | Oct | Summer (Jan-Mar) | GSR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Dandaragan | 4.7 | 28.6 | 28.0 | 20.3 | 38.5 | 68.0 | 94.6 | 83.9 | 32.2 | 12.4 | 61.3 | 349.9 |
| Katanning | 1.6 | 1.6 | 18.8 | 58.2 | 29.6 | 68.6 | 56.6 | 40.0 | 18.8 | 12.8 | 22.0 | 284.6 |
| Gibson | 2.4 | 2.4 | 61.4 | 31.6 | 52.2 | 63.0 | 62.4 | 78.8 | 46.8 | 17.2 | 66.2 | 352.0 |

**FIGURE 1: Flowering (50%) taken as days after sowing of seven varieties sown mid-April and early May at a) Dandaragan and b) Gibson in 2015**




and other varieties sown late May were still flowering when the last frost occurred, making it very difficult to avoid frost in 2015. Frost damage was also observed at the Katanning site.

At the Dandaragan NVT wheat site, a tiny tag temperature logger also recorded some frost events and periods of temperature above 30°C during grain fill.

## Flowering observations

Although Dandaragan and Gibson are at the northern and southern parts of the WA wheatbelt, the time taken to reach flowering after sowing is fairly similar for most of the varieties apart from Mace sown mid-April at Dandaragan (Figure 1). Mace flowered 10 days earlier at this site compared to Gibson.

The spread of flowering between varieties range from just over 40 days between Mace and the winter wheat Whistler when sown mid-April at Dandaragan, compared to two days between Mace and Trojan sown mid-April and early May at Gibson.

Zen, the new longer season ANW had very similar flowering dates to Calingiri. The new APW variety Cutlass appears to have a similar maturity compared to Yitpi.

DAFWA wheat agronomy project manager Christine Zaicou-Kunesch with Richard Quinlan, of Planfarm, and Woongoondy grower Gerard Rowe at the GRDC-funded RCSN early sowing wheat trial site at Yuna. PHOTO: DAFWA

## Grain yield

The average grain yield ranged from over 5.5 tonnes per hectare for the early May sowings at Dandaragan and Gibson to less than 2.0 tonnes at Katanning sown late May (Figure 2). Most varieties obtained their highest yields at the early May sowing time or the yields were not significantly different between mid-April and early May sowings.

The exception was Whistler at Katanning which obtained the highest yield sown mid-April.

Although Mace was one of the lowest yielding varieties when sown mid-April at Dandaragan, Yitpi was the only variety that achieved a significantly higher yield. Overall, yields increased by 1.5 tonnes per hectare by delaying the sowing time until early May (Figure 2a). Visual observations at Dandaragan did not suggest that biomass for the mid-April sowings was lacking in comparison to early May sowings. Ear numbers were recorded to be lower for the mid-April compared to the early May sowings at an average of 341 per m² to 400 per m² respectively.

Mace was consistently the lowest yielding variety at Dandaragan, although it is important to note that it was not significantly different from most of the varieties examined in the trial series.

At Katanning where frost was an issue, Mace was also

Very early sowings (mid April) expose all currently available wheat varieties to frost damage.

consistently the lowest yielding variety at all three sowing times, but Whistler, Yitpi, Cutlass and Magenta yielded significantly higher when sown mid-April (Figure 2b). Cutlass and Magenta again yielded significantly higher than Mace when sown early May but the difference between the varieties when sown late May was not significant.

Figure 2c shows a different variety by sowing time interaction compared to the two northern sites (Figures 2a & 2b). At Gibson, Mace is consistently one of the highest yielding varieties at all three sowing times. The longer maturing varieties Whistler, Yitpi, Harper and Magenta are consistently lower yielding even at the earlier sowing dates. Cutlass is competitive with Mace only at the May sowing times.

### Grain quality

Limited grain quality analysis from Dandaragan and Katanning has indicated that mid-April sowings can have issues with staining of grain and frost distorted grains. At Dandaragan, Cutlass, Mace, Magenta, Yitpi and Zen had stained grain above the maximum limit of 25 but below 75 which would result in a downgrade to UH or GP depending on protein levels.

While at Katanning at the mid-April sowing, all varieties would have been downgraded due to frost distorted grains, including the longer maturing winter wheat Whistler.

Small grain screenings were an issue in 2015 across WA. Data so far indicates a typical response of increased screenings with delayed sowing.

Mid-April sowings can also expose grain to conditions which may result in lower falling numbers.

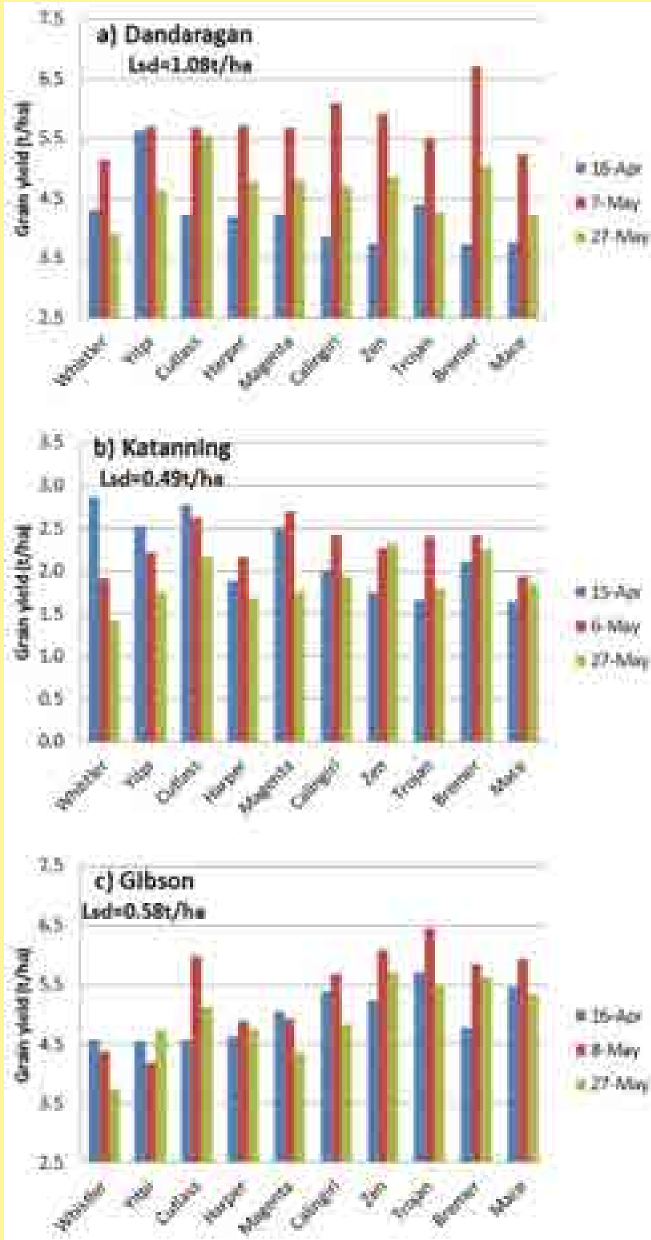
## To sum up

Traditionally, sowing wheat in Western Australia was not recommended until after Anzac Day. This date has been based on the yield performance and maturities of commercially available wheat varieties in the 1990s. Since then, growers have seen the release of Mace, a high yielding and very adaptable variety which at 67 per cent dominates the area sown to wheat in WA in 2015. And growers are now set up and keen to take advantage of any summer rainfall – but there is limited information on which wheat varieties to grow with a very early sowing opportunity.

Research carried out by James Hunt and others in 2014 suggested that the faster maturing winter wheat Whistler appears adapted to WA and when sown in mid-April was able to yield as well as or better than Mace planted in late May.

Results from Dandaragan and Katanning do support this suggestion but our research also suggests there are commercial varieties currently available in WA which can yield similar to or higher than Whistler and have a superior quality classification.

**FIGURE 2: Grain yield (t/ha) response of wheat varieties to sowing time at a) Dandaragan, b) Katanning and c) Gibson in 2015**




Varieties arranged in order of maturity. Frost damage occurred at Katanning and Dandaragan experienced some low temperature events

But these varieties can still be at the risk of frost and grain quality problems associated with very early sowings.

The research continues to highlight the need for a variety which is more suitable for early sowing opportunities in WA.

Work will continue to seek information as to why Mace and other short to mid-season maturing varieties are so successful even when sown mid-April compared to the longer maturing varieties at the Gibson site and if this is unique to the area.

**The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC, the authors would like to thank them for their continued support. This research is also co-funded by DAFWA. Sincere thanks to West Midland Group for the provision of land, to the Geraldton, Katanning and Esperance RSUs for the management of trials and for the technical support of Melaine Kupsch, Bruce Haig, Sue Cartledge, Rod Bowey and Rachel Brunt.** ■

# Canola meal for dairies

By Dennis O'Brien, USDA – Agricultural Research Service

## AT A GLANCE…

- Canola meal is a viable option as a protein source for dairy cattle.
- Dairy cattle fed canola meal produce more milk, more milk protein, and less nitrogen in urine.
- Both high and low-protein canola meal diets provide benefits.

AGRICULTURAL Research Service dairy scientists in Wisconsin (US) are helping dairy farmers weigh the merits of a relatively new option for feeding their cattle: Using canola meal as a protein supplement.

Protein supplements are costly, and dairy producers must decide which protein source to use – soybean meal or canola meal – and how much of it. Dairy producers want to use as little as possible; increasing the amount can increase milk production, but the benefit is usually negligible. Using more protein supplements than necessary also increases urinary nitrogen, often leading to additional nitrogen runoff that pollutes waterways, says Glen Broderick, a former ARS dairy scientist with the US Dairy Forage Research Center in Madison, Wisconsin.

Canola production increased rapidly in the 1990s in the US as a cold-tolerant crop and was initially raised for its seed oil. Canola meal is a relatively new protein source for dairy cattle, Glen says. "Canola meal didn't begin to catch on as a protein source for cattle until years after the crop was first introduced, when extensive breeding led to improved varieties."

Glen (now retired) and his colleagues divided 50 lactating dairy cows into five groups and varied their diets (high and low

ARS scientists fed dairy cattle diets supplemented with canola meal and other protein to study its effects on milk production. (PHOTO: Glen Broderick)

amounts of soybean meal, high and low amounts of canola meal, and a mix of low canola and low soybean meal).

Each group received a different diet every three weeks, and researchers measured the amount of milk, milk proteins, and urine nitrogen produced by the cows while on each diet. The diets were balanced to provide adequate levels of protein and included standard corn and alfalfa silages; corn grain; and the usual supplementary vitamins, minerals, and neutral detergent fibre. The study was partially funded by the Canola Council of Canada.

After 15 weeks, researchers found that the canola meal supplement resulted in more milk and more milk protein per day than soybean meal. The effects were about the same in both the high- and low-protein diets.

Specifically, cows fed canola meal produced an average 39.1 litres of milk per day, compared with 38.1 litres produced by cows on soybean meal – a 2.5 per cent difference per cow.

Cows on canola meal also showed a similar increase in production of milk proteins.

Using canola meal also had an environmental benefit – the canola meal diets produced less urine nitrogen, which could lead to less nitrogen runoff.

In the US canola meal now costs about the same as soybean meal per unit of protein, but the findings could save costs in the long run by giving dairy producers another option in the face of ever-changing prices, Glen says.

**Further information: Ronald D Hatfield, Plant Physiologist, US Dairy Forage Research Center – Madison, Wisconsin. Ronald.Hatfield@ars.usda.gov, Ph: +1 608 890 0062** ■



# Tiny bugs tackle big crop disease problems

MICROSCOPIC soil bacteria with anti-fungal properties are being put to the test as potential biocontrol agents in the war against some of the most costly diseases affecting wheat and canola crops.

Researchers from CSIRO Agriculture have identified strains of soil-dwelling actinobacteria that appear to be effective at suppressing a range of fungal pathogens of wheat and canola.

These actinobacteria include antagonists against the diseases Fusarium crown rot, Pythium damping off, take-all root rot, Rhizoctonia hypocotyl rot and Sclerotinia stem rot that are estimated to cost the Australian grains and oilseed industries more than $250 million annually in lost production and control measures.

## Huge potential

CSIRO's Dr Margaret Roper sees huge potential for development of actinobacteria as biocontrol agents that could be used as seed coats or foliar sprays on wheat and canola.

She said the exciting part of this research was that the promising isolates of the actinobacteria were discovered – already thriving – in WA soils on

Margaret Roper.

White heads of wheat caused by Fusarium crown rot. Native actinobacteria have a huge potential as biocontrol agents for diseases such as crown rot. (PHOTO: CSIRO)

Microscopic soil-dwelling actinobacteria are showing promise as biocontrol agents for wheat and canola diseases. (PHOTO: CSIRO)

roots of wheat plants that were performing well in the face of high fungal disease pressure.

"This means they are already adapted to local conditions and we are also finding they readily take up residence in crop roots and are easy to culture and grow," Margaret said.

From about 300 isolates selected by the researchers, a small group of the bacteria was found to effectively suppress a range of soil and stubble-borne fungal disease pathogens in the laboratory.

Margaret said testing on small wheat plants in a glasshouse also identified two isolates that could reduce fungal disease levels by 75–94 per cent, but further testing of plants grown to maturity – both in the glasshouse and in the field – was required.

She said, if successful in the paddock, the use of actinobacteria as biological control agents applied as a seed coat might become an integral part of integrated fungal disease management in the future.

### Quicker solution than breeding

"This might also provide a quicker solution to combatting disease than breeding disease-resistant wheat and canola varieties," she said.

"The incidence of some fungal diseases is rapidly increasing, especially Fusarium crown rot of wheat and Sclerotinia stem rot of canola.

"With no – or limited – host plant resistance available and disease management strategies difficult to implement, novel and broad-spectrum control approaches are needed.

"To date, fungicides used as seed dressings and foliar sprays provide variable protection depending on the pathogen and timing of application.

"And pathogens can grow and survive in stubble or on the roots of summer weeds and act as a source of infection in the following crop."

Margaret said to be considered successful, any potential actinobacteria biocontrol agents must suppress the fungal disease effectively, survive either in the plant tissues or within the rhizoplane of growing plants and be easy to culture and inoculate on to plants to allow for realistic application methods in the field.

**Contact Dr Margaret Roper, CSIRO E. Margaret.Roper@csiro.au**

**Margaret outlined the major breakthroughs in investigations into actinobacteria at the 2016 GRDC Grains Research Updates in Perth held in late February.** ■

# ASK AN EXPERT – COULD HERBICIDE RESISTANT CROP PLANTS BECOME WEEDS IN THE BUSH OR ALONG ROADSIDES?

**With Roberto Busi, Research Fellow, AHRI, The University of Western Australia**

BACK in 2009, before the commercial release of transgenic canola in Western Australia, some windrowed Round-up Ready (RR) canola plants from a trial site were blown into an adjacent area of bushland during a storm.

For the next four years, Roberto Busi, a weeds researcher at The University of Western Australia monitored the site where the plants had shed their seed.

"Plants established in a on-farm bushland area that wasn't actively managed for weeds," says Roberto. "We monitored the population each year, counting the number of plants, recording plant traits and measuring the amount of seed the plants produced.

"By 2013 the RR canola population was extinct on this site," he says. "Research done in the US, Canada, Europe and Japan show that canola can establish and grow outside agricultural fields but generally doesn't persist. Our data show that, in Australia, transgenic RR canola doesn't persist for more than three years."

**UWA Research Fellow, Roberto Busi monitored sites where RR ready canola had established as a weed and has shown that RR canola does not persist in the environment for longer than three years – the same as conventional canola varieties.**

**When these canola plants were treated with glyphosate, only the non-transgenic plants died, leaving the RR canola to grow without competition. As soon as a herbicide mix was applied, along with mowing and hand weeding, the site was weed-free again.**

### What if RR canola in non-farming areas is actively managed with herbicide?

**Short answer:** It can persist for longer if other plants around it are removed.

**Longer answer:** At another site, we monitored RR canola plants growing in a median strip area near a grain depot. This median strip was sprayed repeatedly with glyphosate, which removed all other plants, leaving the RR canola to grow without any competition for resources. These plants grew well and produced large quantities of seed.

### Is it possible to control RR canola in these situations?

**Short answer:** Yes, it just requires a change in management.

**Longer answer:** RR crops remain susceptible to a wide range of herbicide modes of action. So although they will thrive if the affected area is treated with glyphosate alone, the addition of a different herbicide will effectively remove these plants. We monitored this median strip for two years and in that time the roadside management team introduced the use of different herbicide mixes, mowing and hand weeding to remove the RR canola plants from this site.

### Does RR canola pose any additional weed threat along roadsides or in non-crop areas around farms?

**Short answer:** No, provided land managers are aware that they must not rely on glyphosate alone in these areas.

**Longer answer:** All herbicide resistant crop types have the potential to become volunteer weeds in-crop and along roads and fences. Strategies must be put in place to rotate herbicide groups, as well as non-herbicide tactics like mowing, weeding and even haymaking, to control volunteer plants. ■

## HOW TO ASK A WEEDSMART QUESTION

Ask your questions about managing herbicide resistant crop plants that establish in non-crop areas on the WeedSmart Innovations Facebook page *https://www.facebook.com/pages/WeedSmart-Innovations/354441941389122*, Twitter @WeedSmartAU or the WeedSmart website *http://www.weedsmart.org.au/category/ask-a-weedsmart-expert/*

'Weedsmart' is an industry-led initiative that aims to enhance on-farm practices and promote the long term, sustainable use of herbicides in Australian agriculture.

# World market remains bearish

Profarmer AUSTRALIA
www.profarmer.com.au March 16, 2016

## AT A GLANCE…

- Global markets remain bearish despite reports of adverse weather conditions in the US and India as well as slight changes to USDA WASDE estimates.
- Currency markets and continued support for $A values continue to weigh on local grain values.

WHILE the March USDA WASDE reported declines of 3.5 million tonnes in global wheat production, these were mostly offset by decreases in global consumption. This story was consistent across most commodities.

Overall there was little market reaction in response to this with global markets retaining their bearish tone.

The market will now turn some attention to the USDA's prospective plantings report which is due at the end of March.

### World wheat stocks to use


### Traders continue to build a record net short position

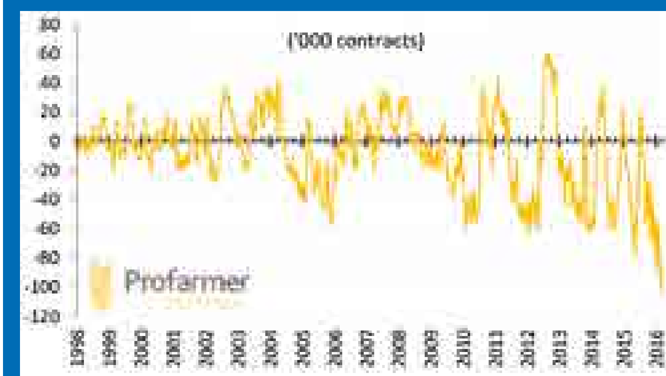
As the chart below shows, within the past year traders have taken on a significant net short position in CBOT SRW wheat futures. In other words, they have speculated that the market will remain bearish/go down.

But in anticipation of the March USDA WASDE report many traders sought to reduce their net short position in case the report delivered some unexpected news. This lead to a short covering rally, with traders trying to offload short positions which provided some price support for CBOT futures.

Despite this the current position of traders remains at it's largest net short position in over 15 years. This remains indicative of a sluggish and bearish global market.

Given the size of the markets short position, should there be

### CBOT SRW wheat



any change in market fundamentals which would push the ‘fair value’ of wheat higher, then traders would likely scrabble to reduce the extent of their net short position. This would again be likely to provide price support.

### AUD finds ongoing support

The AUD has been strengthening against many other currencies including the $US and Euro, on the back of many domestic and global economic influences.

The spot rate of the $A against these two currencies tracked down for the majority of 2015, which provided some support for grain values in $A terms. But the $A has found continued price support over the last month or so, which has worked to somewhat offset some of the gains in offshore grain values.

The price of what are commonly known as ‘hard commodities’ – including oil and iron ore – have found recent support after also moving sharply lower in 2015. This in turn means that commodity currencies – currencies used by/of countries which export a lot of commodities – including the $A, have also found price support.

Another factor effecting these spot exchange rates is relative economic confidence in different economies. Essentially if Australia is trending more positively than say the US, then the $A will generally find price support against the $US.

The US Federal Reserve raised US interest rates for the first time in nearly a decade in December 2015, and the market was expecting rates to continue to gradually rise in 2016.

But since this time there have been some good economic signs out of the US including improved job figures, and some bad economic signs such as stagnant wages growth and a sharp decline in stock market values earlier in the year. As a result there is a lot of conjecture whether increasing rates was the right thing to do. But the market is largely agreeable that US rates will remain unchanged in the short term.

Elsewhere the European Central Bank recently cut their interest rates to zero in an attempt to provide some stimulus to what is presently a lacklustre European economy.

Currency traders have also continued to take on additional long positions in the Australian dollar which provides an indication that the market expects that it will continue to strengthen in the near future. ■

**AUD/USD and AUD/EUR spot**

# Multi-peril insurance can take the stress from risk

By Rebecca Jennings

DROUGHT, frost, fire, hail and rain can all erode yield potential – and if the spring of 2015 is anything to go by – a combination of these events can devastate production. Grains research has delivered new varieties and information to guide growers through managing frost risk or dry finishes, but other management practices can remove stress at 'the pointy end' of the season.

In 2015, South Australian agronomist and Rural Directions consultant Patrick Redden spoke about the role of multi-peril crop insurance (MPCI) in risk management at a GRDC Farm Business Adviser Update in Adelaide.

Historically, Australian crop insurance has been based on single-peril cover, such as for fire or hail. These products are simple to assess and have low levels of 'moral hazard' associated with them, meaning that the risk to the insurer is independent of how the grower manages the crop.

More complex, multi-peril insurance products are not new in Australia's cropping landscape but have waxed and waned with poor grower uptake and limited geographical coverage.

In the past two years, several MPCI products have entered the broadacre market, offering cover against perils such as frost or heat shock that were historically uninsurable.

**The Modystachs made their claim after a series of severe frosts in August 2014 devastated their wheat yield. The cover paid out 80 per cent of their five-year average income from cropping.**

"In some ways, MPCI can be thought of as income protection insurance," Patrick says. "Essentially, it involves purchasing a policy that provides a guaranteed level of income per cropped hectare. The grower can choose the level of cover they wish to purchase based on their cost structure and the need for subsequent cashflow following a low income year."

## Averting the financial consequences of a catastrophy

Patrick says the role of MPCI is to avert a severe or catastrophic loss from occurring. It does not insulate a business from low profitability, but acts as a 'stop loss' when triggered.

He says MPCI can offer farm businesses a level of certainty in income that will be attractive to financiers and useful for businesses undergoing expansion or for young growers who are limited by capital to secure finance.

The ability to 'stop loss' rather than being at risk of a large financial blowout could also be attractive for growers nearing the end of their business life cycle who want to reduce the amount of business wealth at risk from seasonal peril.

MPCI can also have the intangible benefit of reducing stress levels for growers, by reducing financial exposure to frost and heat.

One of Patrick's clients, upper north South Australian grower Kerry Modystach, can attest to this.

Kerry, his wife Gill and their son Matt farm 4000 hectares at Wilmington and Hammond. They took out MPCI in 2014 and had the dubious honour of being the first SA growers to make an MPCI claim after a run of devastating frosts.

"We definitely slept better at night knowing we were insured. It took the volatility out of our farming income that year," Kerry says. "But while MPCI is a good idea and provided peace of mind, and the banks love it, it is a complicated process and expensive."

The product he bought involved a detailed up-front audit (which cost $5000), with the premium based on 10 per cent of their five-year average income from cropping, plus stamp duty.

The Modystachs made their claim after 10 frosts in August 2014 wiped out a substantial amount of their wheat – 100 per cent of some paddocks. The cover paid out 80 per cent of their five-year average, after assessments by their agronomist and the insurance company's assessor.

Kerry opted not to take out MPCI in 2015, as he felt entering the season with substantial stored soil moisture would reduce the risk of a dry season.

After the poor 2014 harvest, their five-year average meant the crop could only be insured for a minimum of 0.8 tonnes per hectare, and he was confident they would achieve this. The decision paid off, with wheat averaging 1.8 tonnes per hectare in 2015.

Patrick says it is important to consider the merits of MPCI based on individual farms, as it does come at a cost and may not benefit every farm business.

MPCI reduces the severity of losses in poor seasons, so in seasons where no claim is required it adds extra cost, reducing profit.

It is unlikely to provide a substantial benefit for farms with low variability in income, as the likelihood of a claim is low.

If a business is struggling to be profitable based on high-cost structures, adding additional costs in the form of MPCI could further reduce the likelihood of profit. But if profitability is threatened due to large fluctuations in income, then MPCI could have a fit.

Each season should be considered on its merits.

MPCI is currently only available for cropping enterprises, so businesses with a substantial livestock enterprise or off-farm income may not justify MPCI solely for the cropping component of business risk.

Understanding profit drivers and risks is critical to evaluating whether MPCI is a good fit for your business.

"MPCI decisions should go hand in hand with historic self-insurance strategies (farm management deposits, strong equity levels and flexible in-season tactics), sound agronomic practices and enterprise diversity to reduce a farm's risk profile," Patrick says.

Weather-related indexes serve a similar purpose to MPCI, but growers take a position on the occurrence of a certain weather event, rather than the outcome of it as is the case for more traditional MPCIs.

## Viable insurance products for Australia

Unlike in the US, where growers access heavily subsidised insurance, the complex nature of MPCI in Australia means it can be difficult to balance commercial return for insurers and attractive premiums for growers. MPCI is challenged by achieving enough geographic diversity to increase uptake, high costs of assessing, processing and administering complex insurance policies, sourcing ongoing funding and reinsurance, and the moral hazard of grower management influencing production outcomes.

With a history of short-lived MPCI products, Patrick says long-term business plans should be sustainable without the guarantee suitable schemes will be offered beyond any given year.

But despite these challenges and the unstable history of MPCI, there remains interest in getting viable products off the ground.

Patrick recommends growers speak to their farm adviser to determine if any of the MPCI and weather index products currently offered in Australia will suit their individual enterprise.

**At a recent GRDC Update, South Australian consultant Patrick Redden, walked growers through the pros, cons and considerations of using multi-peril crop insurance as a farm risk-management tool. This article is based on that presentation.**

**Further information: Patrick Redden, Rural Directions, 08 8841 4500; predden@ruraldirections.com,** ■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*Are you looking to diversify? Well here's a great case study which explores how four farming families found and exploited a niche market.*

# Traceability and freezability proving an export hit

IT'S taken 15 years, but Flinders Ranges Premium Grain (FRPG) in South Australia is riding an export boom for their flour made from a low-yield hard wheat called Katana.

The Ranges' low rainfall and limestone rich soil gives their specialised wheat an elastic protein profile which in turn gives dough made from that wheat an extended frozen shelf life without the inclusion of preservatives or additives. This has made it popular among frozen dough producers in India and the Middle East as well as artisan bread producers in Australia.

"We knew that doing well as a business meant moving away from producing a soft commodity where we were at the wrong end of the pricing chain," says FRPG CEO Peter Barrie.

"We looked at what food producers in different markets required as well as what our four family-run properties in the Flinders Ranges could best produce. We started experimenting with hard wheat. While not as high yield as many grains, the elastic, high protein qualities of the grains opened up premium markets to us – abroad and at home."

## Understand your product's role in the food industry

Ongoing research and development is a hallmark of FPRG's business strategy. From early on, they formed a solid relationship with Adelaide TAFE to test how the flour from wheat grown on their farms performed for different segments of the food industry.

"Discovering how our wheat performed as a baking ingredient led us to identify our niche export market," says Peter. "Once we knew what we needed to provide to frozen dough producers, we continued testing wheat varieties until we found our best for purpose grain."

This emphasis on R&D coupled with 'paddock-to-plate' traceability helped FRPG secure the Bakers Circle India and the Middle East contracts to supply the flour for frozen dough for the regions' Subway stores.

Even with the Indian contract well established, Peter still travels to India, and now Dubai, to check how his flour performs within its production environment and as an end product in the local Subway stores. "It's satisfying being part of the whole production process in all these different places," he adds.

**(L-R) Andrew Byerlee and Peter Barrie of Flinders Ranges Premium Grain in South Australia.** (PHOTO: NAB Agribusiness)

## Consistent quality demands full traceability

Quality, consistency and traceability are equally important for FRPG's large overseas clients. The company has a fully auditable path from farm to shipping that guarantees the clean and green standards of their produce. This traceability involves having their own storage silos and mill, so there is no risk of contamination with inferior grain from other farms.

Australia's reputation as clean and green is a big drawcard internationally. The National Residue Testing Standards are a good base. But Peter points out that most countries and big food manufacturers have their own strict standards. This makes meeting individual customer protocols time-consuming.

"It's another reason single origin grain and flour from small family owned farms holds an international advantage," he says. "We can provide the traceability and quality control. The low rainfall on our properties means fewer chemicals. We don't need fungicides, and we select varieties that are disease resistant. Being a family farm is a definite marketing advantage. Companies and consumers like to know where their flour has come from and have the security of knowing who produced it."

## Find your niche and you find your future

Peter is excited about the future of Australian agriculture and FRPG in particular. While acknowledging that a lower dollar helps, he doesn't shy away from the need to continuously explore new markets and tailor wheat for their needs, saying: "It's a non-stop learning curve for everyone involved".

FRPG is currently working with the University of Adelaide's School of Chemical Engineering to try and double the shelf life of wholemeal wheat and, if international demand is high enough, set up a wholemeal mill.

"We keep one step ahead of the market by identifying and then solving a problem for the food industry," he says.

FRPG went on three government trade missions in 2015. So far, they've steered clear of China because the margins were too low. But that market is opening up for premium primary produce.

"We're looking to diversify into three or four countries plus develop our domestic artisan sourdough flour market," says Peter.

He sees great opportunities for young farmers today. The export market is opening up in exciting ways – if farmers become part of the food industry instead of suppliers of a soft commodity.

"Accept the challenges, and life on and off the farm gets more interesting," advises Peter.

**Drawn from Agribusiness View from NAB Agribusiness. Visit: www.nab.com.au/agriview** ■

# The integrated Harrington Seed Destructor has arrived

*Run hard, look after your mates, shepherd, do the one percenters, plenty of talk, there's no 'I' in team…*

BUT, there's an 'I' in the Harrington Seed Destructor. The integrated Harrington Seed Destructor (iHSD) is here! About 20 years ago Ray Harrington had an idea. That idea has culminated in the de Bruin group commencing the commercial manufacture of the iHSD this year.

Ray didn't do this alone, it was a huge team effort, and the team has had a win.

To learn more about the plans for the iHSD and this great story of teamwork, keep reading!

## Innovation doesn't just happen – you make it happen

Ray Harrington made this innovation happen by having an idea, then building relationships and creating a team to get the job done. He never dreamed that it would take 20 years!

We really want to tell you the story of how it all came together, but first, let's cut to the chase shall we?

The iHSD comprises of two hydraulically driven cage mills that are mounted within the rear of the harvester (just below the sieves). AHRI has determined that the mills can destroy 93 to 99 per cent of the weed seeds that enter them.

The de Bruin group from South Australia have exclusive rights to the manufacture of the iHSD (check out iHSD.com). This was announced at the Perth GRDC Grains Research Update in February 2016.

McIntosh and Son have the rights to the sale and distribution of the iHSD. They'll sell, fit, monitor and provide support to iHSD customers.

## What's the cost?

This info isn't public yet, but we can tell you it'll cost more than a new chaff cart and less than a tow-behind HSD.

## How many and when?

There are already several harvesters that have been fitted and working with iHSDs around Australia and there'll be 10 more by harvest 2016 (all in Western Australia). These are already allocated to customers and the machines will be closely monitored and fine-tuned.

All going well, there'll be significantly more iHSDs in 2017 (14 expressions of interest in two days, including one international). If you think you may be interested in putting your name down for one in 2017 go to iHSD.com.

## What colour harvester?

So far the iHSD has only been fitted to Case harvesters. The 10 new iHSDs in 2016 will be fitted to Case and New Holland harvesters. The plan is to then fit iHSDs to other makes of harvester in 2017.

## Horsepower requirement?

About 80 horsepower. This will vary, but we were pleasantly surprised with this result. The concept is to perhaps run a class 9 harvester at class 8 capacity.

Ray Harrington has had one iHSD on a class 9 Case harvester and another on a class 8 harvester for the past two harvests and both performed extremely well, side by side. Ray says that the class 9 harvester operated at 97 per cent of engine capacity and the class 8 operated at 101 per cent – with both using the same amount of fuel.

We will know more about horsepower, harvest capacity and fuel usage after harvest 2016.

## Are there any negatives?

Don't get us wrong, we're excited about the iHSD, but we're aware of some potential negatives.

- Sheep feed. The iHSD will pulverise not only weed seeds but crop seeds as well. This is likely to reduce the feed available to livestock grazing stubbles. We believe that the chaff cart is likely to continue to be a great option for mixed farmers.
- Difficult to assess harvest losses. Many growers assess harvest losses by observing crop seeds on the ground and/or using a tray thrown under the rear of the harvester to assess rotor losses. This will not be possible where crop seeds are destroyed by the iHSD. But don't worry, Ray is lying awake at night trying to work out how to solve this problem so keep an eye out for yet another invention from him!
- Clearly the iHSD represents additional cost to the farming system. We're sure though, that growers will only undertake this cost if it's good for long-term profit.

**Ray Harrington's good idea 20 years ago has just become a commercial reality.**

The Harrington Seed Destructor is now integrated into the harvester rather than being towed behind.

## And now for the (shorter version of the) story

In the late 1990s, Ray Harrington sold all of his sheep and went continuous cropping in some of Australia's best sheep country. He had seen what other WA farming families had faced with resistant weeds in their continuous cropping programs. And he realised he had to do something with his weed seeds at harvest or he too would hit the wall with resistance (once the honeymoon period was over).

He knew about chaff carts and windrow burning, but wanted to avoid burning his valuable residue.

So he went looking for something to smash the weed seeds to smithereens. Enter Geoff and Mike Glenn and Steve King – 'bush engineers' as Ray calls them. He told them what he was looking for and they found it – a cage mill that was rendering coal into dust to make BBQ briquettes.

A static mill was built and modified, which then sat on Ray's farm for five years, doing very little, until Ray bumped into Professor Steve Powles, the director of AHRI.

This was the beginning of a long relationship with AHRI. Steve appointed Dr Michael Walsh to the project.

The first job was to determine whether or not this mill could destroy the seed of our common weed species. Michael and Steve supervised 4th year ag science student Jason Ellerton. Jason also had a background in engineering.

Jason thoroughly tested the prototype mill with great results on killing ryegrass seed (95 per cent kill). Steve then 'baited a shark hook' as Ray said, and provided some AHRI funding and gave Ray the 'moon shot' ambition of putting the mill behind the harvester.

Ray with his friend Ron Knapp built from scratch a prototype. Thus the 'tow behind HSD' was born, complete with its own 100 hp motor.

GRDC were approached for funding and to everyone's delight they came to the party with significant funds. Michael Walsh was appointed to lead the project.

The de bruin Group, Mt Gambier, South Australia, was appointed by GRDC as the manufacturer and distributor of the tow behind machines.

Ten tow behind units were sold but they weren't exactly flying off the shelf.

### The iHSD was born

Next to join the team were engineer Chris Saunders and PhD student Nick Berry from the University of SA who started working on prototypes for an integrated version – the iHSD was born.

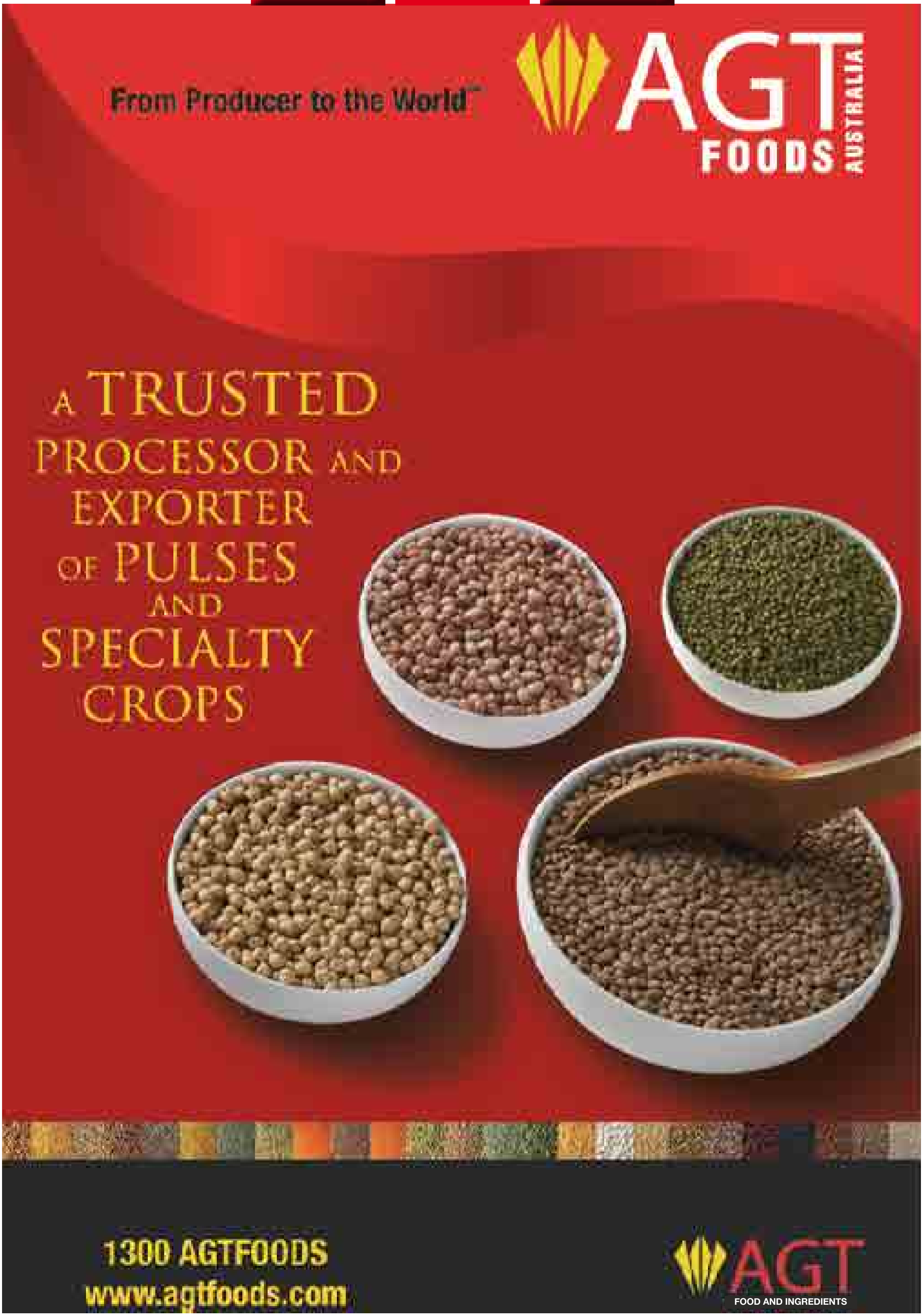
Two mills, each with one moving part, were mounted at the rear of the harvester, just below the sieves, and were hydraulically driven. Eureka!

The theory to use a class 9 harvester and operate it at class 8 capacity was put to the test and it passed with flying colours. The iHSD was ready for market.

The final members to make up the team were the machinery dealers – McIntosh and Son. They'll distribute the machines nationally including fitting, monitoring performance and ongoing support.

And so the team is complete, and what a team it is!

There is no 'i' in team but we're absolutely thrilled that there's now an 'i' in the Harrington Seed Destructor. ■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# ASK AN EXPERT – HOW CAN I IMPROVE PRE-EM HERBICIDE EFFICACY IN HIGH STUBBLE SITUATIONS?

With Catherine Borger, Researcher, Department of Agriculture and Food, Western Australia

MAINTAINING high stubble has many benefits but there is a downside when it comes to applying pre-emergent herbicides, which must be applied to the soil surface to be effective.

An application of 2.5 L per hectare of trifluralin or the full label rate of Sakura would usually be expected to achieve 70–90 per cent ryegrass control in crop, however Department of Agriculture and Food (DAFWA) researcher, Dr Catherine Borger, has shown that the carrier volume has a large effect on the level of control achieved.

Across four trial sites Catherine's research demonstrated that ryegrass control with trifluralin or Sakura increased from 53 per cent control when the carrier volume was 30 L per hectare to 78 per cent control when the carrier volume was increased to 150 L water per hectare in high crop residue ground cover situations.

"The good news is that the effect was consistent, regardless of droplet size – from medium to extremely coarse," says Catherine. "Surprisingly, Sakura responded similarly to trifluralin even though these two herbicides have quite different properties."

"Our four trial sites had stubble covering 50–90 per cent of the ground surface, a factor known to influence pre-emergent herbicide efficacy," she says. "At all sites the average ryegrass control achieved increased as the carrier volume increased."

Expert boom spray set-up may be able to improve efficacy of pre-emergent herbicides at lower water rates but since this is hard to achieve, simply adding more water or slowing application speeds could increase ryegrass control levels with pre-emergent herbicides applied to paddocks with high levels of stubble cover.

### Is increasing the water volume the best way to improve ryegrass control with pre-em herbicides?

**Short answer:** Yes, in high stubble situations high water volumes are the best option.

**Longer answer:** To increase ryegrass control when spraying trifluralin in high crop residue situations the only options are to increase the herbicide rate, or increase the carrier volume (water rate). Since the top label rate of trifluralin is 2.9 L per hectare pre-sowing of wheat, there is little scope to increase the herbicide rate.

### Why did such different products show the same response to water volume?

**Short answer:** All pre-emergent herbicides work best when the product is applied to the soil.

**Longer answer:** Trifluralin and Sakura herbicides have different solubility and adsorption properties. Trifluralin has low solubility and is highly adsorbed to organic matter and Sakura is the opposite, with higher solubility and low adsorption to organic matter. In these trials ryegrass control was similar for both herbicides and increasing the water rate also gave a similar response with both products.

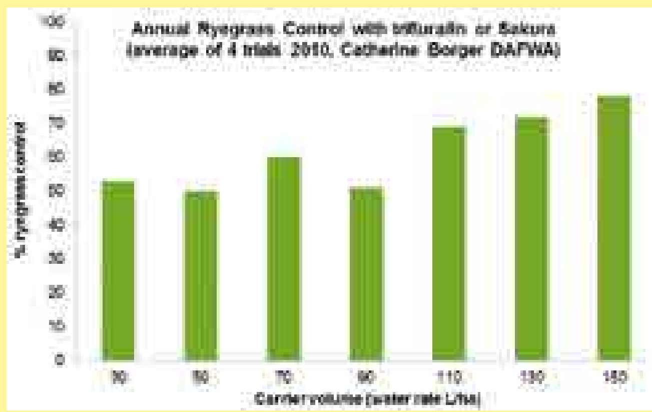
### If droplet size didn't make any difference to weed control rates, does that mean it isn't important?

**Short answer:** No, droplet size is important for several reasons and label instructions must be followed.

**Longer answer:** Set the droplet size to suit factors other than stubble load such as drift risk, delta T (bigger droplets for higher Delta T), mixing partner (for example, medium droplets for paraquat). To evaluate spray jobs, place some water sensitive paper on the ground (in and between old stubble rows) and some vertically on standing stubble. For best results keep ground speeds below 25 km per hour when applying pre-emergent herbicides. ■

Dr Catherine Borger from DAFWA has demonstrated the clear benefits of using high water volumes when applying pre-emergent herbicides in high stubble load situations.

**FIGURE 1: Annual ryegrass response to carrier volume for pre-emergent herbicides trifluralin and Sakura, averaged across four trial sites in 2010**




## HOW TO ASK A WEEDSMART QUESTION

Ask your questions about managing herbicide resistant crop plants that establish in non-crop areas on the WeedSmart Innovations Facebook page *https://www.facebook.com/pages/WeedSmart-Innovations/354441941389122*, Twitter @WeedSmartAU or the WeedSmart website *http://www.weedsmart.org.au/category/ask-a-weedsmart-expert/*

'Weedsmart' is an industry-led initiative that aims to enhance on-farm practices and promote the long term, sustainable use of herbicides in Australian agriculture.

# Safflower and its role in rotations

■ By Kathi Hertel, NSW DPI

## AT A GLANCE…

- Safflower is a winter oilseed crop best suited to be grown in rotation with cereal crops. Agronomic attributes include a role in integrated disease, weed and pest management programs.
- Safflower is heat and drought resistant, adaptable to arid and semi-arid climates as well as irrigation.
- As an oilseed crop, benefits include improved productivity of subsequent crops, lifting farm income, reducing the impact of disease and weeds; and producing edible and industrial quality oil and meal.
- The development of safflower crop technology for the biodiesel industry presents the potential of a significant addition to crop options in farming systems.
- Safflower is grown largely for the food industry in Australia. Research to establish baseline data to develop agronomic management is crucial for future industry development.

SAFFLOWER comprises cultivars that are of two oil types, high in linoleic or oleic fatty acids. Safflower historically has remained a secondary crop. Linoleic cultivars were principally marketed as a component of feed mixes for birds and small animals; and oleic cultivars used in manufacturing industries producing paints, resins, pharmaceuticals and cosmetics.

Areas sown to safflower in Australia vary widely, ranging between 6100 and 45,000 hectares in the decade from 2003.

Reasons for this include few available cultivars, susceptibility to alternaria (*Alternaria carthami*) and phytophthora (*Phytophthora cryptogea*), limited agronomic research, disappointing farmer experiences and adverse seasons. A history of inconsistent prices and market opportunities because of competition from both alternative oilseed crops and the continuing development of petroleum substitutes have further hampered adoption.

Commencing in June 2004, a strategic partnership by CSIRO and GRDC established the Crop Biofactories Initiative (CBI), a 12 year program to examine the potential of plants to make alternative compounds for specific industrial uses, including biofuels, bioplastics and biolubricants derived from high oleic oils.

CBI scientists developed a GM process to produce super high oleic oil (SHO) safflower. Conventional oleic genotypes currently comprise oleic acid levels of approximately 75 per cent of total oil content. SHO lines contain up to 95 per cent oleic acid.

Safflower has a good agronomic fit in some crop rotations.


With its deep roots and long growing season safflower uses more water than most winter crops. (PHOTO: Jack Dykinga)

In 2015, CSIRO issued a licence to GO Resources to commercialise GM safflower technology.

## A good fit in the rotation

Rotation benefits include:

- Late winter crop option if there is a late break or failed establishment of the winter crop.
- Potential to double crop out of sorghum.
- Heat and drought tolerant oilseed crop suited to lower rainfall areas where canola and sunflower are not adapted.
- Broadleaf crop option – break crop for cereal diseases including Crown rot (*Fusarium pseudograminearum*), Common root rot (*Bipolaris sorokiniana*), Yellow leaf spot (*Pyrenophora tritici-repentis*) and Spot form of net blotch (*Pyrenophora teres f maculata*).
- Resistant to both *P thornei* and *P neglectus* root lesion nematodes.
- Safflower is regarded as a good host to arbuscular mycorrhizae fungi (AMF), promoting the increase of AMF in the soil.
- Safflower is subjected to a different weed spectrum to most other crops. It offers the opportunity to control late germinating weeds and/or herbicide resistant winter weeds and to incorporate additional IWM strategies.
- Greater crop enterprise diversity to spread economic and production risk.
- Used in a soil ameliorant role to improve soil structure. For example, used strategically as a first crop in the rotation after cotton to break up subsoil to remove compacted layers, improve aeration and water infiltration; and root development to subsequent crops (anecdotal reports of rooting depths of 2.2 m).

Other (system) advantages include:

- Alternative crop suited to both dryland and irrigation.
- Low input, low maintenance and easy to grow.
- Crop inputs and machinery requirements similar to wheat production.
- Sowing and harvest windows effectively spread peak workloads and machinery use over a longer period, increasing efficiencies and harvest timeliness of different crops.
- Widely adapted to various soil types, but best suited soils with high water holding capacities.
- Safflower is a competitive crop against weeds after the mid to late spring period.
- With deep roots – and providing sufficient water is available – safflower is tolerant of hot summer conditions during crop maturation.
- Utilises soil water deep in the soil profile. Lowers the water table with dissolved salts, reduces water logging in following crops and improves N efficiency by utilising leached N at depth.
- Increasing climate variability presents opportunities for safflower as an oilseed as it can grow on less rainfall than other major oilseed crops such as canola, sunflower and soybeans. Potential to be grown across a wide geographic area.

## Sowing time

- Main sowing window is June to August.
- Flowering can commence in 85 to 140 days – at the end of October and during November (depending on genotype, sowing date and environment).

## Harvest

- Safflower matures in 110–170 days. Harvest period in northern NSW is normally from mid-December through to the end of January, varying with location, seasonal conditions and sowing date.
- The rate of dry down of seeds and stems can vary. Harvest delays can occur when drying down to eight per cent moisture content in the seed (delivery standard) where stems have not dried down sufficiently. Stem dry down can be slowed when periods of rain and high humidity occur and when low crop populations produce plants with thick stems.
- Where food and birdseed markets demand clean bright white seed, timely harvest is imperative.

## Yield potential

- In most seasons, average dryland yields are 1–1.2 tonnes per hectare.
- Anecdotally, the highest known commercial yield is reported to be 3.3 tonnes per hectare under irrigation in northern NSW.

## Marketing safflower

Safflower is currently mainly grown as an oilseed crop comprising two main oil types – linoleic and oleic acid.

**Linoleic acid** is a polyunsaturated (omega-6) fatty acid. The most widely grown linoleic oil cultivar is Sironaria, released by CSIRO in 1987. Linoleic genotypes contain over 75 per cent linoleic acid. Linoleic cultivars are grown for seed and oil.

For example, safflower seed is used in birdseed and small animal feed mixes. Visual seed appearance is an important market criterion with preference given to a bright white appearance. Sironaria is the preferred variety. Other varieties like S317 (an oleic oil variety) are not desirable for this market because of inherent varietal characteristics like a creamy coloured seed coat and grey stripe on the seed.

Large price variations between seasons are common due to the speculative nature of production.

The small market for birdseed and small animal feed mixes is easily over supplied.

Linoleic oil is an edible oil, used in products such as salad oils and soft margarines. It is also used in the manufacture of pharmaceuticals, cosmetics and paint in some other countries.

A by-product after oil extraction is the high fibre meal.

The fibre is important in stock with low fibre diets such as feedlots and dairy. The meal containing around 24 per cent protein is used as a livestock protein supplement. Meal from de-hulled seed has about 40 per cent protein with reduced fibre content.

**Oleic acid** is a monounsaturated fatty acid. Oleic varieties include S317 and S517 which are grown for their oil, for use in the food industry for frying and in the manufacture of pharmaceuticals, cosmetics, soap, paint additives, adhesive and sealant compounds, plastics and lubricants.

Current oleic safflower production – comprising principally S317 – targets the food industry, supplying manufacturers, wholesalers and food service operators. Export in the form of oil or as seed varies with the costs of crushing and oil extraction. Recent increases in crushing costs from $150 to $300 per tonne mean that seed imports have replaced oil imports.

Presently, India is the main market for oleic safflower oil for the food industry, looking to import around 30,000 tonnes of seed. Australia currently falls well short of meeting this – struggling to supply 4000 tonnes of seed.

Safflower is grown under contract on a per hectare basis. Prices paid for oleic safflower in 2014 were $490 per tonne and in 2015, $520 per tonne. Prices are quoted ex-farm, ex-GST.

Contracts are written to Australian Oilseed Federation (AOF) Standards. Payments are based on the percentage of oil in the seed and test weight at eight per cent moisture and four per cent impurities.

The baseline oil content is 38 per cent with applied two per cent discounts and premiums. In 2014, all deliveries exceeded 38 per cent oil.

## Potential industry growth

The unique properties of oleic acid also make it of potential use in biodiesel production. The GRDC reports that indicates global demand for high-purity oleic acid oil could require more than 100,000 hectares of the new safflower varieties.

In the northern region, 'cotton soils' could be classified as 'safflower soils'. Depending on water availability with seasonal conditions, pricing comparisons of crop choice and water costs, and field rotations, some level of substitution may be a potential viable option for some growers.

Having soils with predominantly high water holding capacity, the northern region is an environment that suits safflower with its heat and drought tolerance. Oleic oil synthesis within the seed is favoured by warmer finishing conditions, promoting high oleic content.

The existing expertise with modern agricultural technology, including GM crop production, and the region's pre-existing oil crushing facilities, combine to offer opportunities for the development of an industrial safflower oil enterprise in northern farming systems.

Economics will determine industry growth with competition from profitable crop options.

## Some issues with growing safflower

### Genetically modified (GM) crop

The incorporation of GM safflower cultivars into a farming system may involve guidelines and strategies under a Stewardship program to ensure appropriate on-farm crop management and throughout the grain supply-chain.

### Soil water use characteristics

Safflower uses more water than other winter crops, attributed to its deeper rooting depth and longer growing season. The deep rooting habit dries the soil profile. This has implications for subsequent crops, limiting crop potential where soil water reserves are not replenished by sufficient rainfall in dryland situations. When conditions remain dry, planned crop sequences may be disrupted.

Adequate stored soil moisture at sowing is crucial. Safflower production is a greater risk crop in low rainfall areas when there is low stored soil water at sowing. Limited starting soil moisture and lack of timely in-crop rainfall will produce poor or variable safflower yields.

### Disease and pests

Seasonal conditions largely determine the incidence and severity of disease in safflower. Management includes preventative strategies and variety resistance.

Insect pests include wireworms and false wireworms, heliothis and thrips. Safflower also offers an attractive alternative food source to birds.

### Weed management

Safflower is subjected to a different weed spectrum to most other crops. Its sowing window offers the opportunity to control late germinating weeds and/or herbicide resistant winter weeds and to incorporate additional IWM strategies.

There are few registered herbicides for use on safflower so good weed control prior to planting is necessary.

## To sum up

The suitability of safflower – particularly in the northern region environment – combined with industrial crop technology creates a potential new industry. That is, the ability to produce renewable high purity oleic acid oil suited to a range of compounds that can replace non-renewable petroleum-based industrial chemicals.

But further agronomic research and development is required.

**The research undertaken as part of this project is made possible by the significant contributions of growers through both trial cooperation and the support of the GRDC. The author would like to thank them for their continued support.**

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■

# On-the-go protein mapping

■ By Mathew Clancy, Next Instruments, Condell Park, NSW

TECHNOLOGY within the agricultural industry has developed rapidly in the past 10–15 years. Investment into modern and large scale farming will continue as farmers strive to increase yield and profitability. Precision agriculture will be a key driver in developing technologies to give farmers the data and tools to farm smarter and more efficiently.

Near infrared analysers have been used at bulk handling sites across the country to measure protein, oil and moisture in whole grains for many years. In the past 15 years, farmers have started using on-farm NIR analysers to test their grain prior to delivering or storing. In the past few years, these NIR analysers have been adapted to fit on a combine harvester in order to collect protein, oil and moisture data as the grain is stripped.


**CropScan 3000H remote sampling head mounted to a Case combine.**

A local instrument manufacturer, NIR Technology Systems (now Next Instruments), developed the CropScan 3000H On Combine Analyser that provides farmers with real time moisture, oil and protein measurements. From this data, on-the-go maps can be generated.

## Importance of on-the-go protein maps

In Australia, the prices paid for wheat and barley are based on the protein content as well as hectolitre weight and per cent screenings. But in most other countries, crop payments are not graded by protein content. Nonetheless nitrogen based fertilisers are used throughout the world to increase yield and/or protein content.

Protein paddock maps are therefore important as a means of implementing variable rate fertilisation in order to level out the yield and protein content of the grain across a paddock.

The protein map – combined with a yield map – provides a distribution plot of how much nitrogen has been removed from the soil during harvest. This information can then be used to vary the rate of distribution of fertiliser for the next year's planting.

In order to generate protein paddock maps, an on-combine analyser using NIR technology is required. An analyser that collects data at regular intervals across the paddock – along with GPS coordinates – provides a means of displaying real time paddock maps for protein, oil and moisture.

## 2015 harvest data

By the end of 2015, there were approximately 50 on-combine analysers installed in Australia, the United Kingdom and the US.

The experiences of farmers across Australia are varied. In some

**FIGURE 1: Protein, yield and overlay maps, Bennington Pastoral Co, 2014 harvest**

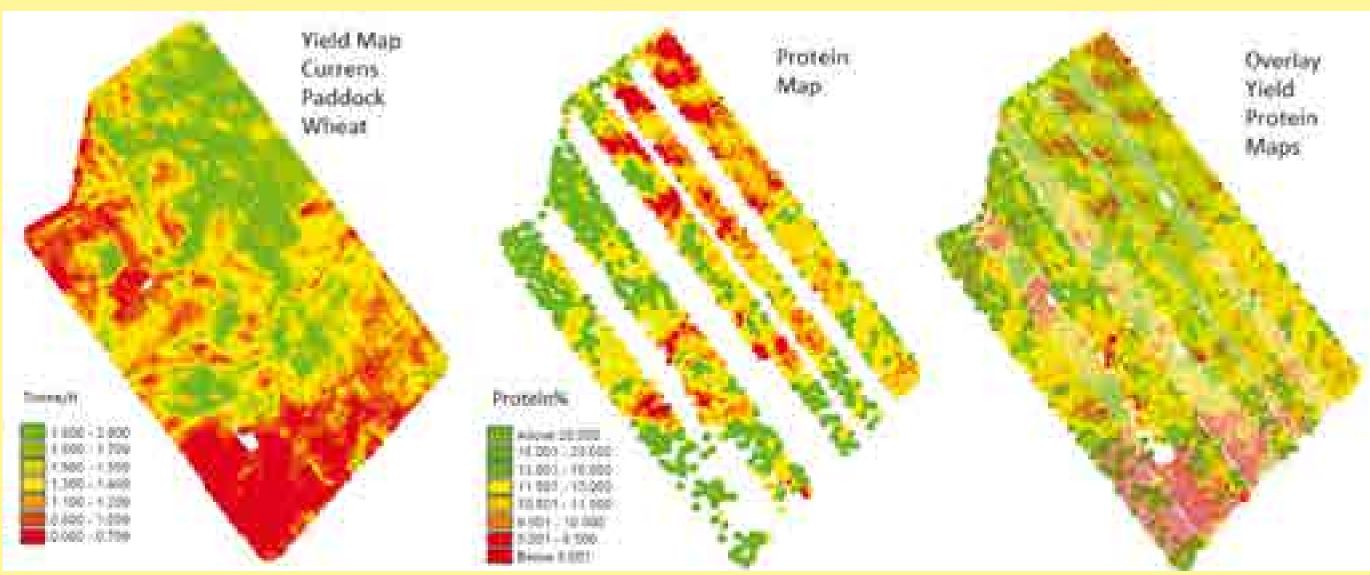
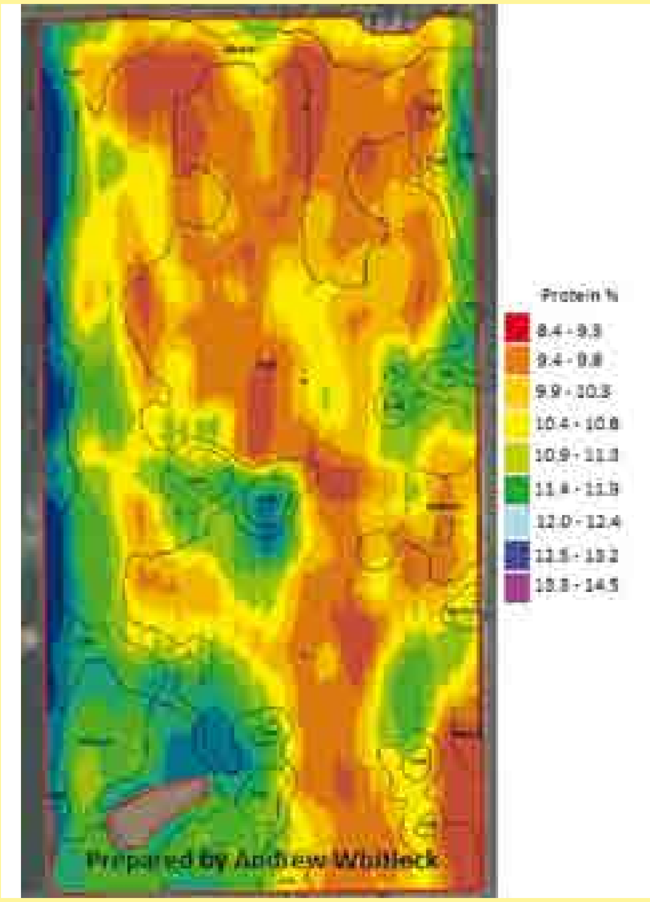


**FIGURE 2: Protein and yield map, Grandview**




locations the dry spring conditions meant that grain screenings were so high that the farmer could not use the protein data to segregate grain. But in other areas, farmers used the data to blend grain in the paddock and to create paddock maps in real-time and post harvest.

The following two case studies outline how on the go protein mapping can be of real agronomic and financial benefit

**Luke Follett, Bennington Pastoral Company, Lake Benaneen, crops approximately 8000 hectares in the far south western region of New South Wales.**

The Folletts operate two Case combines and grow wheat, barley, canola and lupins. They installed a CropScan 3000H into one header in 2013. Figure 1 shows protein and yield maps for one of Luke's paddock for wheat during the 2014 harvest.

Because only one header had the CropScan 3000H installed, there are strips in the protein map where the second header operated without collecting any protein data.

The overlay of the yield and protein maps shows the expected relationship between low yield/high protein and high yield/low protein. As such the correlation between the yield map and the protein map is very high.

There are areas in the paddock where the protein and yield are both mid level – for example the yellow zones. An increase in nitrogen fertiliser may be effective in increasing yield and protein in these areas of the paddock.

An important observation from the protein map is that Luke could choose to blend the grain in the paddock by selectively stripping the red area and combining with grain from the green areas to raise the grade from ASW to APW. In effect, a $30 per tonne increase in grain price.

**Adam Inchbold, HR&C Inchbold, Yarrawonga, crops wheat, barley and canola across 2500 hectares in northern Victoria.**

The Inchbolds operate a New Holland CR series combine. The CropScan 3000H was fitted three years ago. Figure 2 shows a combined yield and protein map for the Inchbold's Grandview paddock where Trojan wheat was grown in 2015. The yield zones are shown as text within a black boundary. The protein values are shown as colour contours on the map.

The central zones – red, orange and yellow – show low protein and high yield. The bottom left zones show areas where there is high protein and low yield. This pattern follows the inverse relation that commonly exists between protein and yield.

But in the bottom right corner, the yield is low and the protein is low. Either more nitrogen was required in these zones or there are other limiting factors involved, such as moisture or soil.

"You can see significant variation in protein," Adam said, "and certainly enough to take the harvested wheat from ASW to APW in places. Unfortunately I do not have a nitrogen offtake map for this paddock. I think it is fair to say there is a trend to yield and protein having an inverse relationship, which will reduce variation in N offtake. But I would still expect N offtake to be interesting in terms of variable rate nitrogen application."

Although further statistical analysis would provide greater insight into what is happening in this paddock, around 50 per cent of the paddock is producing wheat of ASW grade, whereas the rest of the paddock produces APW to AH1.

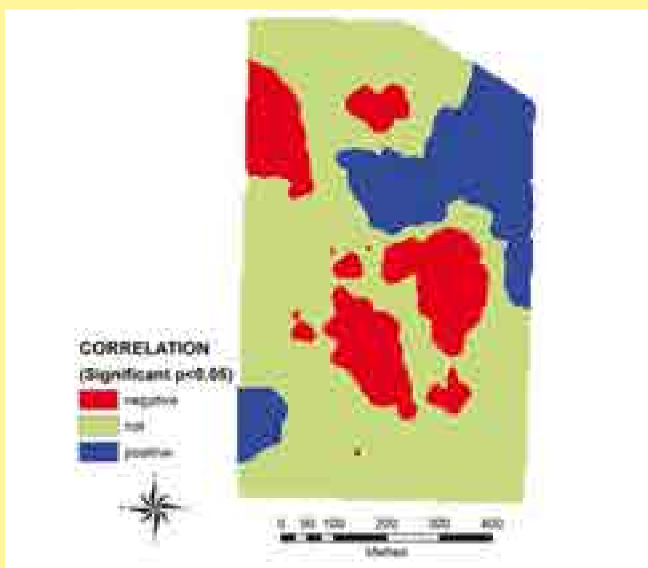
The Inchbolds were able to segregate the grain and then blend to ensure that all loads met at least the APW grade – which realised an extra $30 per tonne across the paddock.

## Significance maps

Brett Whelan, Sydney University, Precision Agriculture Laboratory, has used on-the-go yield and protein data to present 'significance' maps in three colours – for example red, green and blue. Figure 3 is an example.

The red areas are where an increase in nitrogen would increase yield and protein. The green areas are most likely producing an optimum yield and protein. The blue areas represent land that is suffering from lack of moisture or there is some other problem in the soil. In these areas, the source of the problem needs to be addressed rather than waste money on more fertiliser. ■

**FIGURE 3: Significance map**



# AGFACE looks at the impact of climate change in Australian crops

By Maryse Bourgault, The University of Melbourne

AT the Paris climate conference late last year, 196 countries agreed to limit their greenhouse gas emissions and thus limit the increase in global temperatures. The most common greenhouse gas is carbon dioxide, which plants (amazing things they are!) use during the day to build sugars through the process of photosynthesis.


Maryse Bourgault.

Atmospheric carbon dioxide concentrations ($CO_2$) have increased from about 280 ppm to 400 ppm from the pre-industrial era until now and are predicted to reach 550 ppm by 2050. The world is also now emitting more $CO_2$ and greenhouse gases than what the Intergovernmental Panel on Climate Change (IPCC) considered in 1992 the most fossil fuel intensive high economic growth scenario.

For many plants such as wheat, rice, canola and pulses, increasing $CO_2$ makes photosynthesis easier and acts as a fertiliser. For other crops such as maize and sorghum, which already concentrate carbon dioxide in specialized cells, the impact on photosynthesis is minimal, but increased $CO_2$ still helps crops be more efficient with the water they have. So what's the problem? Why should we worry about climate change and what it means for Australian agriculture? Shouldn't we be burning fossil fuels like there is no tomorrow?

The problem is that increased $CO_2$ in the atmosphere will not come alone. The gas molecules of $CO_2$ capture some of the energy from the sun and keep it in the atmosphere. The Earth's atmosphere is like a big blanket, and by adding more greenhouse gases, we are making it warmer. This, then, is likely to affect Australian crops with a higher incidence of heat waves and warm days, but also through higher minimum temperatures which might speed up crop development.

## The AGFACE research program

The Australian Grains Free Air $CO_2$ Enrichment (AGFACE) research program was established in 2007. There were other FACE systems internationally looking at the effects of increased $CO_2$ on crops, but these experiments were conducted in environments with higher natural rainfall and/or irrigated agricultural systems and there were concerns that they might not apply to relative low rainfall Australian dryland agriculture. Over


A lentil elevated $CO_2$ ring in 2014.

Side experiment looking at grain protein in field peas in 2015.

the past eight years, we have grown wheat, canola, field peas and lentils in octagonal rings, half of which are receiving the high $CO_2$ treatment (approximately 550 ppm) through $CO_2$ released into the air from pipes just above the canopy.

In the absence of higher temperatures, we observed that elevated $CO_2$ does increase yield on average by approximately 25 per cent. For example, averaged over the five cultivars, yields of

Maryse Bourgault and Russel Argall hand sowing lentils in the 2014 season.

Imposition of heat stress with purpose-built chamber under ambient $CO_2$ in 2014.

field pea increased by 25 per cent in 2010 (from 5.0 to 6.3 tonnes per hectare), 16 per cent in 2011 (from 3.6 to 4.2 tonnes), and 39 per cent in 2012 (from 2.6 to 3.6 tonnes) under elevated $CO_2$.

In lentils in 2014, yields were quite low and we therefore saw a spectacular 146 per cent increase with elevated $CO_2$, averaging around 0.4 tonnes per hectare for the ambient $CO_2$, but approximately 0.95 for the elevated $CO_2$ plots. On a commercial scale, with the high price for lentils at the end of this season, such fields would have been worth harvesting under elevated $CO_2$ – but it would have been a crop failure under ambient $CO_2$.

## Making the most of higher $CO_2$

Recently the AGFACE program has moved from what we call effect studies – questions such as "How much more growth and yield do we get from elevated $CO_2$?" – to a physiological breeding approach in which we try to make the most of the positive effects of elevated $CO_2$. We are investigating how much variability there might be between cultivars of various crops in the response to elevated $CO_2$ and if so, what the genetic basis for this might be. This type of information can then help breeders ensure this is incorporated into new cultivars.

While we have not been able to find cultivars that consistently respond with greater yield, we found that some field pea cultivars maintained their grain protein levels under elevated $CO_2$ while others did not. Lower protein levels under elevated $CO_2$ are quite common in wheat and other cereals, but as pulses are inoculated and are fixing their own nitrogen, we did not expect to see decreases in grain protein.

I conducted a small experiment trying to dig into this last season (now I just need to find the time to analyse the results!).

As mentioned previously, the real effects of climate change will be a combination of elevated $CO_2$ and higher temperatures, but also potentially different patterns of rainfall and drought. Both heat and drought are complex stresses to impose experimentally – their effects will vary according to the crop development, the duration of stress and the intensity.

As a start in this direction, we are integrating heat shock treatments (three days at 40°C) with purpose-built chambers in combination with elevated $CO_2$ to see if $CO_2$ makes crops better able to sustain the stress and/or if the benefits of elevated $CO_2$ are maintained under heat stress. I'm afraid I'm going to have to keep the suspense – I don't have the answer yet!

**AGFACE is a collaborative effort between the Primary Industries Climate Challenges Centre (PICCC), Agriculture Victoria (Victorian State Department) and the University of Melbourne. It is supported by funding from the Grains Research and Development Corporation and the Commonwealth Department of Agriculture and Water Resources.** ■

# Common antibiotic inspires hunt for a new herbicide

PLANT biologists at The University of Western Australia have discovered that the commonly used antibiotic ciprofloxacin, which kills bacteria, also kills plants by blocking the DNA copying machinery of the plants.

The research, which was published recently in The Journal of Biological Chemistry, is a collaboration between UWA researchers and Professor Tony Maxwell from the John Innes Centre in the UK.

The work at UWA was carried out by graduate research assistant Julie Leroux and Dr Joshua Mylne, a Future Fellow in UWA's School of Chemistry & Biochemistry and affiliated to the ARC Centre of Excellence in Plant Energy Biology.

## Possible new mode of action

Joshua said the researchers found a plant that could grow on ciprofloxacin and by working out which gene mutation enabled this, could prove how the antibiotic killed plants.

"This could be the starting point for making a completely new herbicide," he said.

"The DNA copying machinery in plants and microbes have similarities, but also differences that could be exploited.

"The machinery that ciprofloxacin affects is not currently targeted by known herbicides, making this an untried mode of action to focus on."

Joshua said the UWA research team's contribution was to provide the plant proof that the mutated gene was responsible for its ability to grow on ciprofloxacin.

This work built on prior knowledge from Professor Maxwell's lab that the enzyme DNA gyrase (part of the DNA copying machinery) is made in plants and is essential in plant growth and development.

By generating mutations in the model plant Arabidopsis thaliana and finding one plant that is resistant to the antibiotic ciprofloxacin and analysing its genome, the team confirmed that DNA gyrase in plants can be targeted effectively by this antibiotic.

"We envision changing ciprofloxacin in ways that will stop it from being an antibiotic, while improving its suitability as an herbicide," Joshua said.

**Contact: Dr Joshua Mylne (School of Chemistry & Biochemistry)**
**P: 08 6488 4415 M: 0458 490 905**

■

**Professor Tony Maxwell from the John Innes Centre in the UK.**

**Normal *Arabidopsis thaliana* and the ciprofloxacin resistant mutant growing on a graded range of ciprofloxacin concentrations.**

**Julie Leroux, Graduate research assistant at UWA.**

**Dr Joshua Mylne, a Future Fellow in UWA's School of Chemistry & Biochemistry.**

# A new canola variety with Group B and triazine tolerance

By Peter Norris

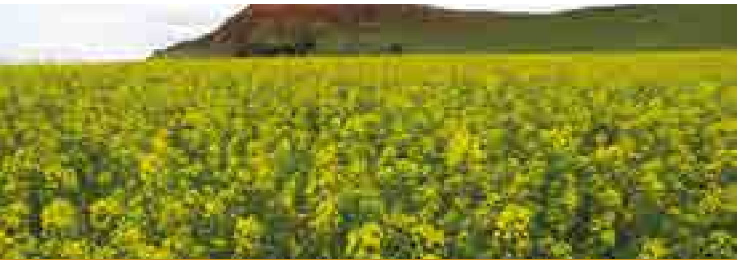
ARE you tired of spending half a day to clean out your boomspray before spraying your canola? Then, are you still nervous about damaging your crop? Are you growing Scope barley and potentially have Imi herbicide carryover and wondering how to get around the three year TT canola plant back?

Some of these were a concern for me on my small farming property near Geraldton, WA, and I have been working for five years to solve this problem.

The answer is Yetna Convenient Canola and it is the solution to all these problems. Yetna also offers at least one new opportunity (see box story below).

Some key points about Yetna canola:

- Yetna Canola is a standard non GM *brassica napus* canola variety.
- Yetna is Triazine Tolerant and tolerant to most group B herbicides. The SU group will gives some transient crop effect/ damage. The Imi group herbicides do not.
- Some Imi herbicide product plant back periods are up to 32 months to TT or RR canola. Yetna canola will tolerate these herbicides and hence will have a 0 month plant back.
- Yetna is a selection from CBWA Tribune canola. Yetna will yield similar to Cobbler in most situations. Oil is usually within one per cent of Cobbler's oil result. New TT varieties will out-yield Yetna except where group B herbicides are present. In 2015 it was in five NVT sites in WA and four Delta Ag sites in NSW.
- When spraying Yetna there is no need to decontaminate the boomspray for SU herbicides! Usually a good flush, load up and go. (Phenoxy products will need the washing detergent clean and flush). This will greatly reduce the worry of spraying canola crops.
- Yetna Canola will allow summer spraying with group Bs in the mix and the use of knockdown tank mixes with group B spikes.
- Yetna will flower a week later than short season varieties allowing a week longer window to get good rates of clethodim sprayed on the crop.
- Blackleg tolerance has been assessed by the national testing program and the results should be released soon. At this stage we assume it is similar to Tribune – Single gene *brassica sylvestris* derived resistance. Yetna should not be grown closer than three years after the previous canola crop. If blackleg can be a problem, then use in-furrow fungicide and blackleg suppressing seed dressing.
- Yetna should be treated as a TT canola variety that will tolerate group B herbicide residues. It is not recommended, at this stage, that it be directly sprayed with group B herbicides. More research is ongoing to establish the yield reduction, if any, from commercial rates of group B herbicides.
- All radish control products except herbicide groups B and C will control Yetna volunteers.
- Yetna is a 4 maturity and will start flowering two to five days later than most mid season varieties.



A Yetna canola crop in 2013 that had 5 grams per hectare of chlorsulfuron applied with the atrazine post emergent spray. This chlorsulfuron would have severely damaged other TT canola varieties.

## How group B tolerant is Yetna?

A picture tells a thousand words.

This photo is taken looking along a 5 g per hectare of metsulfuron (Ally) plot. The dead canola in the foreground is Yetna's parent, Tribune, and the green strips are Yetna plots running across this photograph. The far dead strips are replications of Tribune and Cobbler with the Yetna still happily alive. This site has had 2.2 kg of atrazine and is at Durawa, 32 km north east of Geraldton.

## Why the name Yetna?

It is named after a district of the shire of Chapman Valley where I grew up. Yetna is north east of Geraldton.

**For more information about this variety and to order some seed please speak to your Synergy Consulting Agronomist or email Peter Norris at Agronomy For Profit: afp@westnet.com.au or phone 0428 850 850.** ■

## THE NEW OPPORTUNITY – 'PEAOLA'

Yetna canola's unique herbicide tolerance allows it to be successfully sown with field peas. The peas will dominate the mix early and they climb the canola as it bolts. The canola plants act as a trellis for the peas allowing the crop to be harvested with a standard header front. The two seed types can be easily separated by grading the grain.

Research is ongoing into the 'Peaola' crop.

# New post emergence weapon against winter crop insect pests

ADAMA last year released the new insecticide Pyrinex Super – a unique broad spectrum insecticide providing outstanding knockdown and residual control of key insect and mite pests during winter crop establishment. Initially released for bare earth treatment prior to crop emergence and for early foliar protection in canola, Adama have now extended the registration to include early post-emergence control across a full suite of broadacre crops.

Bevan Addison, market development manager at Adama, says it's really exciting to now have a highly effective solution like Pyrinex Super available for use post emergence across the key broadacre crops like wheat, barley, peas, lupins and canola.

"Pyrinex Super was highly successful in 2015 when applied prior to crop emergence," said Bevan. "Agronomists and growers who used Pyrinex Super gave us really positive feedback. The new post-emergence application now allows growers the flexibility to take out key pests prior to crop emergence and now also take them out on emerged crops."

Many growers will put a bare earth application of insecticide on as an insurance policy against pest attack but often the insecticide treatment can run out once the crop is up and away and pests can still come in and cause damage. This is where Pyrinex Super now offers the flexibility to protect the crop for up to eight weeks from a bare earth application but also take the pests out of emerged crops as well if necessary.

Bevan Addison, Market Development Manager, Adama.

## Combination of two actives

A key feature of Pyrinex Super is its combination of two benchmark active ingredients (chlorpyrifos and bifenthrin) which helps manage resistance in red legged earth mite. While there has been synthetic pyrethroid resistance for some time in RLEM, a relatively new development in WA is the detection of early signs of organophosphate resistance – also a commonly used class of insecticides by farmers.

The use of a dual mode of action product like Pyrinex Super can offer a significant improvement versus the many single active products with respect to managing resistance.

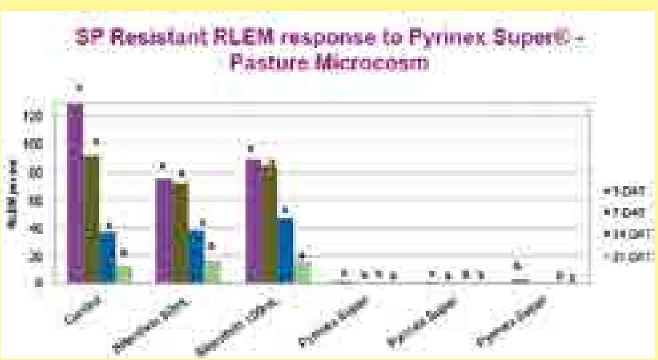
"Trials of Pyrinex Super, such as the microcosm trial highlighted in Figure 1, show that it provides excellent knockdown and length of residual control of key pests including synthetic pyrethroid resistant RLEM – even the lower rates providing excellent control 21 days after treatment," Bevan said.

Where growers are not sure of the resistance status of their pests Bevan highlights that under a service offered by CESAR out of Parkville in Victoria, they can send pest samples for determination of resistance status. This service is free for Australian grain growers, thanks to funding from GRDC, and the collaboration and support of The University of Melbourne, the Department of Agriculture and Food, Western Australia (DAFWA), CSIRO and the University of WA.

Bevan encourages growers to take advantage of the offer. More details are available on the CESAR website.

Pyrinex Super represents a new level of protection for the major broadacre grain crops and against a broad spectrum of difficult to control establishment pest species. ■

**FIGURE 1: Microcosm trial, Parkville, Victoria, 2012 – CESAR**




Means followed by same letter do not significantly differ (P = 0.05)

**FIGURE 2: RLEM canola damage**

# District Reports…

**March–April 2016**

## Western region


**Our WA North district reporter Peter Norris has just launched Yetna Convenient Canola. This new canola is both triazine and Group B tolerant (see article p 48). One of the benefits of this unique herbicide tolerance profile is that Yetna can be successfully sown with field peas. In this 'peaola' crop the field peas dominate the mix early and then climb the canola as it bolts. The canola plants act as a trellis for the peas. Peter's wife Wendy is pictured here in a 2015 Yetna canola and Twilight field peas mix (peaola) at Moonyoonooka, just east of Geraldton.**

### NORTH

There has been very little rain over the past couple of months in WA's northern cropping region.

Summer weeds, germinating from the December rain plus the odd thunderstorm, have been sprayed out.

Farmers are generally busy planning and preparing for the coming season – spreading lime, cleaning seed and getting machinery ready are the major activities.

Burning of harvest chaff piles and windrows will also start around the middle of March. Fertiliser spreading will also be on the jobs' list over the next few weeks.

For mixed farmers, stock feeding is already underway.

Outside of these jobs, time is also taken up in hoping for good rain to wander in and get our confidence up for the coming year.

**Peter Norris**
**Agronomy For Profit and Synergy Consulting, Geraldton**
**March 11, 2016**

### SOUTH COAST

Seasonal conditions on the South Coast have been relatively dry over the past two months – most growers have now had a well deserved break after the challenging end to the 2015 season. Focus is now on the final preparation for the 2016 crop with reality now sinking in that seeding could start in less than four weeks.

Most summer knockdowns are now complete. The whole region has good levels of stored soil moisture that has been conserved from harvest and mid January rains.

**Construction of an Auspan grain shed at Jerdacuttup to assist with handling high moisture grain during challenging South Coast 2015 harvest conditions.**

Extensions on a Bredal spreader to achieve consistent and reliable spreading of lime over 12 metres in controlled traffic farming systems.



Current paddock activities include lime and gypsum spreading, deep ripping compacted soils, surface drain construction, clay delving, spreading and incorporation.

**Quenten Knight,**
**Agronomist, Precision Agronomics Australia**
**March 17, 2016**

# Southern region


## SOUTH AUSTRALIA

### Weather

January rainfall was above to very much above average in most of the agricultural districts. Rainfall in small areas on Western Eyre Peninsula and the Lower South East was below average.

February rainfall varied from the highest on record on the southern part of Lower Eyre Peninsula to very much below average in small areas of the Northern Mallee.

A number of heat waves were recorded during January and February accompanied by several days of strong hot winds.

Mean maximum temperatures for January were average on Western and Central Eyre Peninsula and above average in the remainder of the agricultural districts.

Mean maximum temperatures for February were below average on the Far West Coast and a coastal strip of the South East and average across the remainder of SA's agricultural areas.

### Winter 2015 review

Harvest was completed in all districts by mid-January.

Despite the hot, dry finish to the season and frost damage in some areas, cereal yields were average to above average in most districts.

Pulse yields were severely affected by the hot dry conditions and yields were well below average.

There was a high proportion of lower quality cereal grain with high levels of screenings and low test weights, increasing the amount of grain classified into lower grades or stored on-farm.

Most farmers on Eyre Peninsula and the Mid North delivered some lower quality grain into the bulk handling system at lower grades. Where possible, some was either blended or cleaned to improve quality.

In the Mallee and Upper South East more of the poorer quality grain was stored on-farm and this is now being sold into domestic markets.

Mixed farmers have stored additional poorer quality grain to supplementary feed or finish lambs and other livestock to target weights.

### Preparing for the 2016 season

Spraying of summer weeds that had germinated following rains in November continued into January.

Further rain in January and February resulted in a second germination of weeds and many farmers have sprayed twice – and some three times – to conserve soil moisture and nitrogen.

Stored soil moisture levels are generally only low to moderate across the agricultural districts, despite heavy summer rainfall.

Farmers have been cleaning seed in preparation for the coming season.

Hot weather in January enabled control of snails in some districts.

Early indications are that the area sown to cereals will remain relatively stable but there could be significant changes to the area of other crops. The area sown to canola will increase on Lower Eyre Peninsula but fall in most other districts.

The area sown to lentils will increase in the Mid North and Yorke Peninsula, while the area of peas is likely to fall.

Heavy rains in February caused some damage to lucerne seed crops in the Upper South East, with early crops the worst affected. Record high seed prices will help off-set seed damage.

### Pastures

Rains reduced feed quality in stubble paddocks but summer weeds and volunteer cereals that germinated after January and February rains are providing some feed in pasture paddocks.

Perennial pastures responded to January and February rains, producing good levels of high quality feed.

Stubble paddocks have been heavily grazed in most areas of the state and very little valuable feed is still remaining, where weeds have been controlled. Volunteer crops are providing useful feed where they have not been controlled.

Most producers have started feeding hay and grain to livestock.

Due to low pasture growth last year, across the state there is a greater risk of soil erosion on many light sandy soils.

Supplementary feeding of livestock is occurring in most districts..

**Primary Industries and Regions SA**
**March 4, 2016**

# District Reports…

**March–April 2016**

## WIMMERA/MALLEE

Most parts of the Mallee received some rainfall over summer with up to 120 mm falling in some areas. Consequently, summer spraying occurred in February and early March as growers set about preserving any stored soil moisture.

Farmers are now preparing for sowing so they are ready for when the break comes. Even if it remains dry into April, most sowing programs will be underway by April 25 with the majority of Mallee growers prepared to sow a large proportion of their crops dry.

Given two poor seasons in the southern Mallee, growers are keeping a close eye on farm budgets.

The focus is on minimising costs while maintaining yield potential.

Fertiliser rates will most likely be kept to a minimum at sowing, with many growers opting to top-dress later in the year when they have a better idea of how the season is shaping up.

The results of soil tests carried out on paddocks are now being analysed and will provide a good indication of how much phosphorus and nitrogen is likely to be required.

As far as rotations go – and owing to the last two seasons having below average rainfall for some parts of the Mallee – we can expect to see a higher percentage of paddocks go into cereals.

Unless a good break occurs sometime in the next month, we are not likely to see too much canola around.

The high prices on offer will motivate growers to plant more area to lentils this year.

**Tim McClelland**
**Birchip Cropping Group**
**March 17, 2016**

## NSW OVERVIEW

The El Niño event continues to decline and has now reached moderate levels. A return to neutral conditions is expected. A La Niña event is possible, but somewhat less likely.

Dry, hot and windy weather during February and early March has caused major declines in topsoil moisture.

### Rainfall

February rainfall was below average across nearly 75 per cent of the state, and near-average across most of the remainder.

Rainfall distribution across most of the western and central areas of the state was variable. Rainfall varied from 5–50 mm in areas of the west, north west, Riverina, central west and central tablelands, but some areas received less. The best rainfall occurred across the mid-north coast.

### Climatic outlook and ENSO

The Bureau of Meteorology's rainfall outlook for March to May is near-neutral for most of NSW. This means there is a near-equal chance of drier or wetter than normal conditions. Wetter than normal conditions are likely over south west and areas of north western NSW.

The March to May temperature outlook indicates warmer than normal daytime temperatures are likely across most of NSW, with a near-neutral outlook for the far west. Overnight temperatures are also likely to be warmer.

During March, there is a near-neutral rainfall outlook for most of NSW. Drier than normal conditions are likely in areas of the south east and south west.

The March temperature outlook suggests that warmer than normal daytime and overnight temperatures are likely across NSW.

The El Niño event peaked in November, and central equatorial Pacific sea surface and subsurface temperatures are continuing to decline. Sea surface temperatures in the central Pacific are now at moderate El Niño levels.

Most models suggest a return to neutral conditions in late autumn-early winter, with some suggesting a La Niña event by late winter or spring. The effects on rainfall across NSW in the autumn after an El Niño event tend to be limited.

# District Reports…

**March–April 2016**

### Crops

Harvesting of early-sown sorghum crops in the north has been completed, and later sown crops are approaching maturity. Modelling suggests that yield prospects for later sown crops in the north (sown after a winter fallow) have declined, but generally remain average to slightly above average.

Interest in late maturing dual-purpose winter crops remains high.

### Pasture growth

Pasture growth declined sharply as a result of the hot, dry conditions in mid-late February and early March, particularly in the west of the state as well as some central areas and the northern tablelands and the upper Hunter valley. Relative to historical records, growth was below average across areas of the northern half of the state and the upper Hunter valley. It was near average across most of the southern half of NSW.

### Seasonal growth outlook

For March to May, the AussieGRASS pasture growth outlook suggests below average to average growth for the west, north west and western Riverina, average growth for the central west, and above average growth for areas of the south and the central and southern tablelands. Below average growth is suggested for areas of the coast, Monaro, Hunter valley and northern tablelands.

The growth outlook should be regarded with some caution as it currently has a low to very low past accuracy.

**Harvesting of early-sown sorghum crops in the north has been completed.**

## 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) | 2016 rainfall to date (mm) | Summer 25yr Annual Average (mm) | Summer 2015–16 | Autumn 25yr Annual Average (mm) | Autumn 2016 to date | Winter 25yr Annual Average (mm) | Winter 2015 | Spring 25yr Annual Average (mm) | Spring 2015 |
|---|---|---|---|---|---|---|---|---|---|---|
| Emerald Qld | 539 | 319 | 252 | 419 | 100 | 6 | 60 | 43 | 122 | 74 |
| Toowoomba Qld | 663 | 195 | 277 | 264 | 127 | 33 | 82 | 63 | 121 | 181 |
| Roma Qld | 572 | 194 | 252 | 252 | 117 | 0 | 72 | 100 | 126 | 73 |
| Goondiwindi Qld | 612 | 213 | 254 | 348 | 120 | 0 | 96 | 133 | 135 | 79 |
| Narrabri NSW | 630 | 135 | 227 | 176 | 118 | 0 | 126 | 98 | 160 | 114 |
| Gunnedah NSW | 650 | 71 | 232 | 144 | 112 | 0 | 129 | 107 | 177 | 112 |
| Dubbo NSW | 603 | 126 | 199 | 186 | 122 | 2 | 128 | 172 | 152 | 120 |
| West Wyalong NSW | 443 | 76 | 119 | 95 | 78 | 5 | 118 | 189 | 126 | 95 |
| Wagga Wagga NSW | 541 | 86 | 130 | 109 | 110 | 15 | 151 | 259 | 143 | 160 |
| Swan Hill Vic | 318 | 51 | 73 | 48 | 62 | 9 | 89 | 83 | 95 | 41 |
| Bendigo Vic | 509 | 52 | 108 | 51 | 102 | 15 | 167 | 113 | 136 | 79 |
| Horsham Vic | 379 | 59 | 77 | 63 | 70 | 8 | 132 | 61 | 107 | 46 |
| Lake Bolac Vic | 519 | 74 | 114 | 100 | 99 | 10 | 160 | 113 | 152 | 67 |
| Murray Bridge SA | 369 | 63 | 67 | 40 | 80 | 31 | 128 | 83 | 99 | 54 |
| Kadina SA | 339 | 71 | 57 | 38 | 76 | 43 | 120 | 112 | 88 | 60 |
| Cummins SA | 391 | 90 | 50 | 83 | 90 | 15 | 175 | 176 | 82 | 59 |
| Esperance WA | 614 | 93 | 78 | 112 | 142 | 25 | 249 | 211 | 144 | 104 |
| Wagin WA | 395 | 50 | 43 | 88 | 94 | 0 | 171 | 107 | 89 | 52 |
| Northam WA | 399 | 74 | 38 | 83 | 85 | 0 | 192 | 176 | 86 | 40 |
| Mingenew WA | 354 | 20 | 27 | 22 | 91 | 0 | 176 | 137 | 68 | 33 |
| Moora WA | 382 | 36 | 41 | 40 | 86 | 0 | 183 | 221 | 72 | 40 |
| Mullewa WA | 326 | 25 | 46 | 34 | 96 | 0 | 131 | 135 | 50 | 13 |

Last rainfall reading March 14 2016.

# District Reports…

## March–April 2016

The growth outlook is based on the expectation of wetter than normal conditions across southern and central NSW, with a drier than normal outlook for the north east and a near-neutral outlook for the north, far south west and most of the coast. This is reasonably consistent with the Bureau's outlook.

### Soil moisture

AWAP modelled topsoil moisture levels declined across most of the state to low levels during February, with the exception of areas of the coast.

**NSW Seasonal Conditions Summary, NSW DPI**
**March, 2016**

## Northern region


### LIVERPOOL PLAINS

Near zero rainfall over the past couple of months on the Liverpool Plains has been very challenging for dryland summer crops. Early sown sorghum crops are being harvested with surprisingly impressive yields, with later sorghum crops showing signs of moisture stress.

The area sown to dryland cotton is growing slowly in the district, particularly with the low price of sorghum. And I'm guessing there will be even more interest in cotton this coming season with the release of Bollgard 3 – which will lend itself favourably to the dryland areas of the plains.

The lower end of the valley around Blackville and Quirindi has benefited more from the mid-season rain.

On our farm, we are currently keeping weeds at bay in fallow, and will soon get onto mapping EM using a Veris U3000. This will give us an insight into soil EC, organic matter and pH.

Soil EC is soil electrical conductivity and it gives us an idea of our soil's texture. Smaller soil particles, such as clay, conduct more current than larger silt and sand particles.

We will then use this EC, OM and pH data to establish variable seeding rates – and variety – for this coming summer crop… providing the La Niña the long range forecasters are talking about comes through.

Here's hoping a wet autumn is on its way.

**Lauren McGavin,**
**Precision Seeding Solutions, Premer**
**March 17, 2016**


**The area sown to dryland cotton on the Liverpool Plains is steadily increasing.**

### DARLING DOWNS

#### Summer crop

The dry weather since mid-February has been excellent for harvesting, but not for helping fill the pods of the large area of mungbeans which were double cropped into winter ground,

Sorghum has been the main crop harvested with 70 per cent of the crop off, and much stored on-farm looking for a better price. Most of the crop was planted early and had good early growing conditions. Pest pressure was occasional with heliothis only an issue for the first crops and sorghum midge a problem for the late crops.

Yields have been in the range of 2.5 tonnes per hectare to 7.5 tonnes west of Dalby – very much dependent on storm rain, with an average of 5 tonnes per hectare. The Eastern Downs has fared better with dryland crops yielding between 2.5 tonnes per


**Ripe mungbeans on the Darling Downs approaching the dessication stage.**

hectare for crops hit by the pre-Christmas hail and wind to 10.5 tonnes, with an average yield around 7 tonnes. Irrigated sorghum has been yield tested close to 12 tonnes per hectare.

Quality has generally been good but there have been high screenings from the hot weather, especially at flowering time.

The mungbean area was up to 300 per cent of the average, with many crops double cropped into winter ground.

Establishment was fair, as was weed and insect control, but the dry finish has affected yields. Disease and crinkle leaf have been noticed more this season. Many crops are still to be harvested, but the early yields range from 0.1–1.5 tonnes per hectare, averaging about 1.2 tonnes. There have been a couple of excellent longer fallow yields at 2 tonnes per hectare.

A fair amount of the Downs corn was hit by hail, but other yields have been good, although most crops are still to be harvested.

The cotton is being defoliated on the eastern Downs with dryland yields dependent on the rainfall but expected to be 5–8 bales per hectare, and irrigators hoping for 10–12 bales. West of Dalby picking of dryland cotton has started with 4–5 bales per hectare expected and irrigated crops being defoliated now.

### Winter outlook

Growers are concerned about the current dry conditions, with everyone hoping for good autumn rain to allow double cropping of chickpeas into sorghum ground. The longer fallow country has fair stored moisture.

The chickpea area is expected to be similar to last year's record planting. This is largely due to its high price, especially compared to the low cereal prices, but there is concern about crops being planted close to last season's stubble, and the disease risk if we have a wetter winter.

The barley area should be similar to 2015 but the wheat area is expected to drop.

**Hugh Reardon-Smith**
**Agronomist, Landmark Pittsworth**
**March 16, 2016**

## CENTRAL QUEENSLAND

### The weather

The 2016 summer in CQ has been very hot and dry with a few scattered and isolated storms across all districts. Only paddocks under what were frequently narrow storms finished up wet enough to plant. Many long-fallowed paddocks are still too dry to plant. Scattered, isolated 'spring' storms have been the norm and have continued right throughout summer. We missed a good summer drenching from a widespread rain influence.

The Dawson was wetter in spring so has generally fared better throughout summer. The Callide was wet in spring but missed out on rain at Christmas and remained dry until February. The patchiness of the rain is typified by the Callide where the northern end around Wowan is very dry and the southern end around Thangool is wetter.

On the central highlands, the central area, Emerald to Duaringa has been wettest, with Capella and north very dry except for a few paddocks that got lucky with a storm or two.

South of Emerald to Rolleston has been mostly dry with a few properties and paddocks faring a little better.

### Summer crop

**Sorghum:** Given the current low price someone suggested if you are growing sorghum this summer you are doing it for the experience – not for the money. My guess is that there is less



than 80,000 hectares of sorghum planted across CQ with almost none in the Callide, a few paddocks in the Dawson and some paddocks scattered across the central highlands.

The central highlands crop was planted very late with much of the crop planted in February. There has been no rain since. With very few exceptions, yields are likely to be low to modest at best.

**Mungbeans:** Low sorghum prices and high mungbeans prices have been enough enticement for many new growers to plant mungbeans. This will be a steep learning curve for some! There was a large area of mungbeans planted across CQ but both the spring and the summer crops have mostly encountered tough growing conditions across all districts.

The biggest area of spring crop was planted in the Callide which had a wet start but a very dry finish. The earlier summer

# District Reports…

## March–April 2016

crops fared better than later planted summer crops. Many of the late summer planted crops need rain in the next two weeks or will fail. My guess is about 15,000 hectares of spring and 40–50,000 hectares of summer mungbeans were planted. Yields will vary enormously from fail to better than one tonne per hectare.

**Cotton:** This summer about 18,000 hectares of cotton was planted on the Emerald Irrigation Area and 3000 hectares on the Dawson. Hot, dry, sunny days set up the best ever yields for cotton in CQ. Round bale pickers are quick so about 70 per cent of the crop has been picked.

While yield and quality are still to be assessed, a week of rain just as the pickers moved in has not been good.

### Winter crop

All districts need rain and lots of it for winter crop planting to begin. About 100 mm would be a minimum order – even for the wettest paddocks.

**Chickpea:** A record area of chickpeas of potentially greater than 100,000 hectares will be planted in CQ given even moderate rainfall during April. If it rains, seed and herbicide will be the limiting factor – not paddocks to plant.

**Wheat:** An increase in the area planted to chickpea will result in a reduction in the area planted to wheat, although some paddocks not planted to sorghum this summer may be planted to wheat to provide groundcover.

### Weeds

Many paddocks across CQ are bare of stubble either because they have missed crops due to drought or they have been cultivated to control mature weeds. Feather top Rhodes grass (*Chloris virgata*) continues to be a major weed problem in CQ and a common reason for ploughing.

More cases of hard to kill (potentially resistant to glyphosate) sweet summer grass (*Brachiaria eruciformis*) are being reported. Common hard to kill broadleaf weeds include milk thistle or sowthistle, tridax daisy and fleabane.

### Livestock and pastures

While the rain has been underdone for cropping it has been good, but short of excellent, for grass growth. Most paddocks have grown good quantities of grass this summer but lack of follow-up rain has meant that many paddocks – especially where stock numbers are high – are now well mown going into autumn. Generally, cattle across CQ are in good to excellent condition.

### Water

The Fairbairn dam has had some inflow in the last month and is currently at 43 per cent capacity or 560,000 ML.

**Maurice Conway**
**Department of Agriculture, Fisheries & Forestry**
**Emerald, Queensland**
**March 18, 2016**

**Katy Carroll, DAF Emerald – Technical Officer, inspecting a crop of mungbeans at 'Wyena Park', the Jambin district property of Trent Allenden. Mungbeans are a major summer crop in the Callide Valley.**

## IAN'S CLASSIC TRACTOR QUIZ ANSWERS

1. Field Marshall.
2. Ballarat.
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4. France.
5. Alfa Romeo.
6. 10-20.
7. Ford Model T.
8. Cranvel.
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