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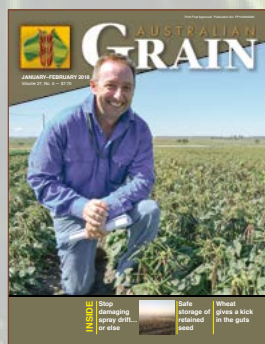
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## FRONT COVER



Queensland DAF senior extension agronomist, Kerry McKenzie, said that row spacings of 25 cm have given peak yields in all situations with all varieties in all seasons. See article Northern Focus page i.  
(PHOTO: Neil Lyon, Grain Central)

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

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**A**FTER better than expected yields in some key winter crop production regions of Western and south-eastern Australia, the 2017-18 winter crop might just have limped through to the finish line with around 35 to 36 million tonnes finally in the bin. This is not too bad a result given the very dry winter and early spring conditions in most regions. Very good grain weights, particularly in WA, have helped push yields upwards.



The 10-year production average for the national winter crop is 39.8 mt so we look like we've come to within about 10 per cent of that. This is not a bad effort given the season – and it's fair to say that 15 to 20 years ago not too many headers would have left the shed. Our collective and modern agronomic talents and techniques are bearing fruit.

So much for the winter crop – the current summer planting started out full of promise thanks to some late and widespread spring rainfall. But the taps have been largely turned off since then. Rain is desperately needed across the northern region to help the crops in the ground as well as to replenish fallows being prepared for winter crops.

## Where are the Greenmount farm tours off to?

It's pretty clear that our *Greenmount Travel* farm tour members are very interested in venturing into the more edgy agricultural destinations – but they're also keen to comfortably and safely take in the different cultures and stunning landscapes these 'out there' destinations invariably have. Our six tours on offer for later this year tick all of those boxes.

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# AUSTRALIAN GRAIN

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## In this issue...

### Selfish weeds can manipulate the nitrogen cycle

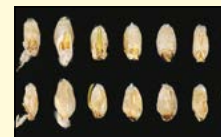
Weeds are selfish, self-centred, narcissistic, manipulative pieces of work that will do whatever it takes to make themselves look good and make the other plants around them look bad.



See article ..... Page 8

### Saving weather damaged grain for seed

Grain retained for seed that is harvested following wet conditions requires attentive management if a healthy crop is to be established next season.



See article ..... Page 14

### Brian's dilemma

I received a phone call the other day from my old bushy tailed mate, Brian. You will note, I referred to Brian as 'old'. The reasons for this descriptive adjective are three fold.



One – we have known each other for many years and shared numerous stimulating adventures with our classic cars. Two – he is one of these rare specimens of humanity that is actually older than me, but to be honest, only just! Three – I use the term as a definitive complimentary interpretation.

See article ..... Page 18

### Australian canola into the EU

Australian canola farmers have reason to celebrate, with news their crop will be eligible to enter the valuable EU market as an environmentally-friendly biodiesel feedstock.



See article ..... Page 28

### Minimise spray drift – good farmers manage it!

We all have a very clear obligation to contain all pesticides to their intended target, legally, morally and most importantly – environmentally. All too frequently we are seeing herbicide drift damage from most of the chemical groups and to all types of crops. If as an industry, we don't take proactive steps to fix this problem, a very large and unwelcome legislative stick will.



See article ..... Page 38



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NSW grower Andy Stewart, pictured with Syngenta Territory Sales Manager Alec Duffy.



*"Honestly, it's the cleanest crop we've ever had, and we usually apply two fungicides, which I haven't had to do this year."*

Wayne Newbey of WA (pictured left with farm manager) commenting on the families wheat crop treated with UNIFORM.

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# Plan ahead key to crop nutrition

**G**ROWERS are being encouraged to get into the paddock now to understand what their crop nutrition needs are likely to be in 2018. International Plant Nutrition Institute (IPNI) regional director Dr Rob Norton said it was important that growers test for nitrogen (N), phosphorus (P) and in some cases also for potassium (K) following what was a predominately low rainfall season.

"Growers need to be approaching their nitrogen management in a way which is both strategic, that is developing management approaches for nutrients where there is little or no other options for intervention, and tactical, where nutrient interventions can be implemented effectively," he said.

"When I say tactical, I mean mapping nutrients, but also understanding what can change. I often use Donald



**IPNI regional director Rob Norton is encouraging growers to get into the paddock now to help understand what their crop nutrition needs are likely to be in 2018.**

Rumsfeld's expression of the 'known knowns' which are what has been removed from your paddocks (yield), what are your nutrient concentrations and what is your likely nutrient supply, which is where soil testing comes in.

"This then helps you to make decisions and offset the 'known unknowns' which are what will be the demand of your next crop and what are the likely losses of supplied nutrients due to seasonal conditions, and then there is the 'unknowns' which includes things like frost, bugs and late heat."

## Nutrient removal and soil testing

Rob said with nutrients the first and most important thing to consider is removal and soil testing.

"If you consider, with removal, what's going out the gate. A five tonnes per hectare 12 per cent protein yield of wheat is likely to remove 100 kg per hectare of nitrogen, 15 kg per hectare of phosphorus, 18 kg per hectare of potassium and five kg per hectare of sulphur (S).

"While canola figures for a three tonnes per hectare yield will be 90 kg per hectare nitrogen, 15 kg per hectare phosphorus, 20 kg per hectare potassium and 15 kg per hectare sulphur.

"These numbers changed in the case of a frosted wheat crop being cut for hay, which may be a nine tonnes per hectare hay yield, then nitrogen removal goes up to 160 kg per hectare and potassium to 180 kg per hectare. Stubble burning will also change those numbers.

"These figures are the mean numbers from long-term data on the GRDC National Variety Trials (NVT), so it should be noted the mineral concentration variation can be significant from site-to-site and year-to-year, and if you want to be sure then nutrient sample testing is a good strategy."

In terms of replacing these nutrients, in the example of phosphorus, Rob said it needs to come from either soil supplies and or fertiliser inputs.

"So, for that five tonnes per hectare wheat crop, you will need 75 kg per hectare monoammonium phosphate (MAP), 200 kg per hectare urea and 45 kg per hectare muriate of potash (MOP).

"But to be certain on inputs, soil testing, deep soil testing is absolutely critical to check if a crop will respond to nitrogen and potassium in particular.

"Nitrogen and sulphur, as anions (negatively charged), tend to move deeper into the profile with rainfall, but on sandy acid soils, potassium (a positively charged cation) can also be mobile and leach into the lower root zone, although it is not as mobile as nitrogen or sulphur."

Rob said in the north, assessing deeper (10–30 cm) phosphorus, potassium and sulphur supplies has shown benefits as this is where the roots will draw water and nutrients from, especially as the topsoil is often dry during the growing season. These deeper zones can be nutrient depleted and so deep-placed nutrients can provide a strategic nutrient backup in those regions.

"Fertiliser rates applied at sowing may need to be increased for these nutrients to ensure they remain at adequate levels in the developing root zone," he said.

"By combining these 'known knowns' and doing your best to understand the 'known unknowns' growers can maintain a nutrient strategy which is both tactical and strategic."

**More information on soil testing is available in the GRDC Southern and Northern Fact Sheets, as well as the GRDC crop nutrition extension hub as well as the IPNI website.**

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## Selfish weeds can manipulate the nitrogen cycle to suit themselves

Weeds are selfish, self-centred, narcissistic, manipulative pieces of work that will do whatever it takes to make themselves look good and make the other plants around them look bad. If they had their own Facebook profiles they'd be full of selfies of the weeds looking a million dollars and the crop around them looking dreadful.

Some weeds are so self-obsessed that they can manipulate the soil nitrogen into a form that is just the way they like it.

New research by Dr Cathryn O'Sullivan from CSIRO is showing that some weeds release chemicals from their roots that slow down the bacteria that are essential to the nitrogen cycle, retaining nitrogen in the ammonium form that weeds can potentially take up faster than crop plants. Totally selfish!

In this research, Cathryn focused on some common Australian weeds, including wild radish, brome grass, wild oats and annual ryegrass.

No prizes for guessing which of these weed species was the champion of inhibiting the soil bacteria. You guessed it, wild radish once again shows us why this plant is so competitive with the crop.

Having said that, all of these weed species did inhibit the nitrification process, but the wheat variety Janz did not.

For more on this research proving that weeds are truly motivated by their own self-interest, read on below.



Dr Cathryn O'Sullivan.

### How do you take your nitrogen?

Most plants love their nitrogen in the nitrate ( $\text{NO}_3^-$ ) form. Most soil nitrogen, whether it be from fertiliser or decaying organic matter starts its life in the ammonium ( $\text{NH}_4^+$ ) form.

How do we remember that ammonium =  $\text{NH}_4^+$ ?

Easy, ammonium has a sum (+).

It's the job of bacteria in the soil to break down ammonium into nitrate. Plants can take up ammonium a little bit, but it's tightly bound to the soil so the plant roots must reach it and absorb it from the soil particles. For this reason, most plants prefer their nitrogen in the form of nitrate because this is floating around in the soil water making it easy to access, and easy to take up through the roots.

At this stage, and we don't know for sure, but it seems that our common crop plants in Australia prefer nitrate, and some of our weeds may be better than our crop plants at taking up ammonium. This will be the focus of future research.

There are a couple of stages in the process of converting ammonium to nitrate, and this research refers to the first step in the process, so to keep it simple this is all we will discuss.

### The bacteria

There are a number of soil bugs that are involved in the nitrification process. This study focused on the bacteria *Nitrosomonas europaea*. They are the 'lab rat' of soil nitrification bugs that other similar studies have focused on.

### How the weeds manipulate the soil

In short, the weeds release chemicals from their roots known as root exudates that inhibit the growth these bacteria-retaining nitrogen in the ammonium ( $\text{NH}_4^+$ ) form, stopping the formation of nitrate ( $\text{NO}_3^-$ ).

At this stage, we don't know what these chemicals are but we know they exist as a result of this great research by Cathryn O'Sullivan and others from CSIRO.

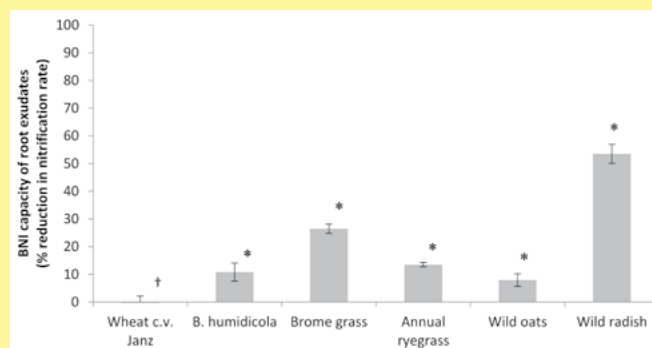
### Experiment 1: Hydroponic test

The first part of this research involved growing the weeds hydroponically, then extracting the root exudates from the hydroponic solution. The researchers then applied this root exudate to a pure sample of the ammonia oxidising bacteria, *Nitrosomonas europaea*, and measured nitrate production.

Figure 1 shows that all of the weeds reduced the nitrification rate by the bacteria, with wild radish having the greatest effect.

This data (Figure 1) is clear evidence that the weeds release exudates that inhibit the bacteria's ability to carry out the nitrification process.

**FIGURE 1: Hydroponically-grown weed root exudates and effect on nitrate production**



Note: BNI stands for biological nitrification inhibition. O'Sullivan Cathryn A., Whisson Kelley, Treble Karen, Roper Margaret M., Micin Shayne F., Ward Philip R. (2017) Biological nitrification inhibition by weeds: wild radish, brome grass, wild oats and annual ryegrass decrease nitrification rates in their rhizospheres. *Crop and Pasture Science* 68, 798-804.

### Experiment 2: Soil test

The researchers then took this study a step further and analysed the effect in soil. They grew the weeds in pots and then pulled out the weeds and shook the soil from their roots, giving them a sample of soil from the weed's rhizosphere and bulk soil.

The data in Figure 2 shows that the effect was even greater in the soil than in the hydroponic test.



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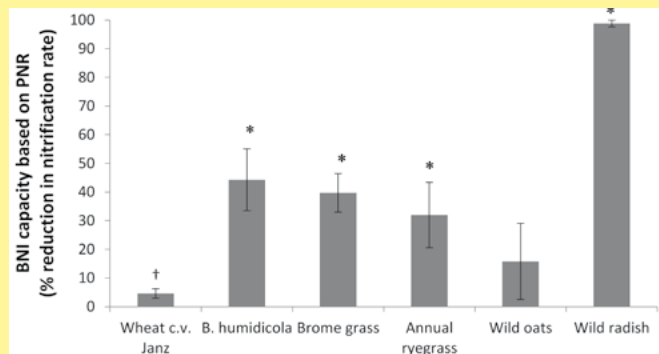
This nitrification research focused on *Nitrosomonas europaea* – the ‘lab rat’ of soil bacteria.



In the US, native wheatgrass can suppress the invasive weed cheatgrass (pictured) because wheatgrass can utilise N in the ammonium form.

Wild radish completely inhibited nitrification, with all of the other species having an effect. Interestingly, the wheat variety Janz, had very little inhibitory effect on nitrification which is further evidence that our crop plants prefer their nitrogen as nitrate.

**FIGURE 2: Pot-grown weed root exudates and effect on nitrate production**



O'Sullivan Cathryn A., Whisson Kelley, Treble Karen, Roper Margaret M., Micin Shayne F., Ward Philip R. (2017) Biological nitrification inhibition by weeds: wild radish, brome grass, wild oats and annual ryegrass decrease nitrification rates in their rhizospheres. *Crop and Pasture Science* 68, 798-804.

## Why would the weeds do such a thing?

It's possible that some weeds may be able to take up nitrogen in the ammonium form. If they can modify the soil bacteria so that most soil nitrogen stays as ammonium, the weeds will have an advantage over the crop that prefers nitrate.

We don't know for sure that the weeds in this study have the ability to take up ammonium, but there are other examples where this happens.

Native wheatgrass in the US has the ability to hold nitrogen in the ammonium form in exactly the same way the weeds in this study have. Wheatgrass can utilise the nitrogen in the ammonium form, but the invasive weed, cheatgrass, prefers nitrate. This has allowed the native wheatgrass to suppress invasion from cheatgrass.

Future research will focus on how our Australian weeds can utilise the different forms of nitrogen in the soil. This could potentially lead to changes in fertiliser use that favour the crop over the weed.

## To sum up

Weeds are called weeds for a reason. They are the masters of invasion and they use sneaky tricks to give them an advantage over our crops. This is very interesting research that could one day give us another tool in our arsenal against our selfish weeds. ■



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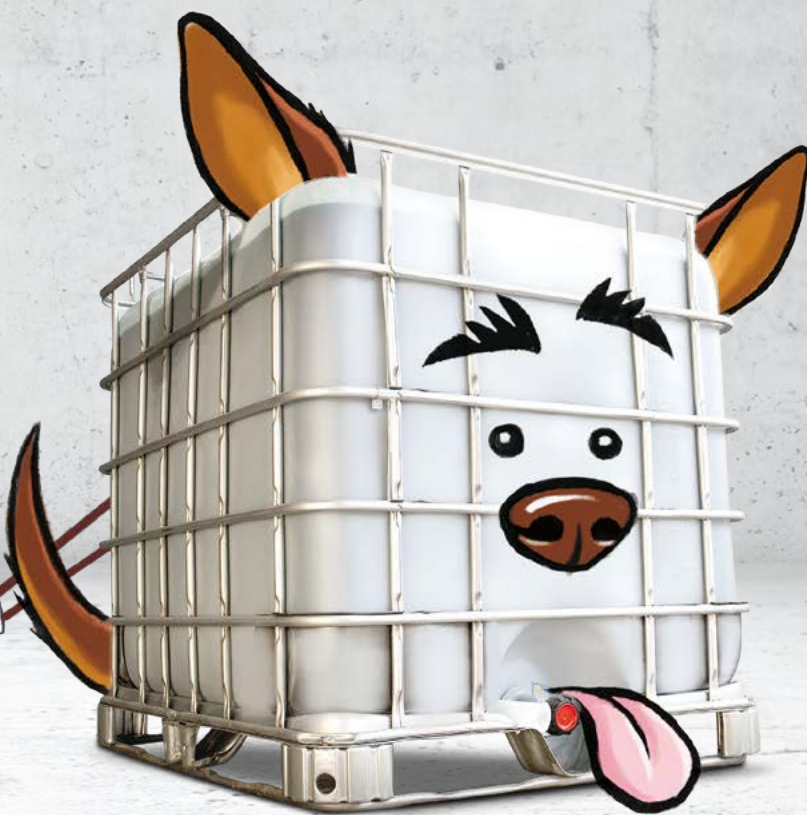


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# Test chickpea seed for mould or frost damage

**C**HICKPEA growers are being encouraged to have seed tested to assess germination and any impacts from frost or mould after many regions had a season marked by frosts and late rain.

New South Wales Department of Primary Industries (DPI) Senior Plant Pathologist, Dr Kevin Moore said there had been reports of 'field mould' in chickpeas delivered to receival points following the 2017 harvest.

So growers are being encouraged to send in all chickpea samples, not just lots intended as planting material for 2018 crops.

"Some chickpea seeds loads were been discounted or rejected for having 'field mould'," Kevin said.

"So we are encouraging growers to send samples of all chickpea seed into the DPI pathology unit for free testing to determine if field mould is present or if other factors – such as the frosts that occurred during August and September – have contributed to the discolouration.

"It is possible, in some cases it could be a combination of both issues, because if frosted seeds are exposed to moisture in-crop or during storage they are more prone to mould than non-frosted seeds."

He said some seed samples from the Narrabri region in northern NSW had been tested and the discolouration found to be more likely due to frost injury than mould.

Kevin said grower samples were vital to assist researchers capture as much information as possible to help determine the relative contributions of frost, immaturity and mould to this chickpea defect.

## Research into grain defects

Capturing data about chickpea defects on the back of weather damage is also part of a collaborative GRDC and NSW DPI project focused on eliminating grain defects in chickpeas.

NSW DPI Senior Research Scientist Dr Jennifer Wood is heading the research into chickpea seed quality and defects and said frosted grains were typically smaller, shrivelled and often darker brown in colour. Immature seeds can also have a similar appearance being small, shrivelled with green cotyledons.

## FREE TESTING OF CHICKPEA SEED

Growers can send chickpea seed samples for free testing to the NSW DPI pathology unit at Tamworth for frost and mould testing.

- Samples of harvested seed should be sent in 500g quantities and representative sample of the entire crop.
- Information submitted with samples should include variety, location, date sown and harvested, flowering and maturity dates (if available) and weather events dates (if known) that could have stressed the crop in the field.
- Samples need to arrive before the end of February 2018. This will ensure results are back to growers before next season planting.
- Samples should be addressed to Dr Kevin Moore or Gail Chiplin, NSW DPI, Tamworth Agricultural Institute, 4 Marsden Park Road, Calala, NSW, 2340.

Jennifer said the 2017 season late rain on maturing chickpea plants in some regions had caused a flush of new growth and podding at the tops of mature plants, resulting in immature seeds at harvest.

She said both frosted and immature defective seeds were classified into the same defective seed category at receival with a maximum tolerance of six per cent by weight, including a maximum of two per cent poor colour.

"It is really important we get as much information as we can on this issue and ideally we would like samples from growers straight off the header."

These samples will be tested by both Kevin (germination and pathology) and Jennifer (non-pathological seed defects) as part of joint DPI and GRDC projects. There is no charge for this service.

To learn more about chickpea seed discolouration go to <https://www.youtube.com/watch?v=GfucEUwE2p8>



Normal, frosted and mouldy chickpea seeds from the 2017 season. (PHOTO: NSW DPI)



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# Saving weather damaged grain for seed

■ By the Grains Research & Development Corporation

## AT A GLANCE

- Ideally retain seed from grain harvested before rain.
- Weather damaged grain is more susceptible to poor germination, low vigour and degradation during storage and handling, so extra care is needed.
- Harvest at low moisture and cool temperatures. Storage temperature and moisture must be monitored and controlled.
- Germination percentage should be checked at harvest, during storage and before seeding. Low germination seed should not be used.
- Do not retain seed from hybrid canola.
- Correct seeding depth, conditions and agronomy are essential when sowing weather damaged seed.

**G**RAIN retained for seed that is harvested following wet conditions requires attentive management if a healthy crop is to be established next season. This management starts at harvest and continues through storage, handling and seeding.

All crops are susceptible to deterioration in seed quality during wet harvests. Mild symptoms can be a loose and wrinkled seed coat. Severe symptoms can be seed staining and fully germinated seed. It is essential to recognise whether the damage is cosmetic or the symptom of a seedborne disease and if it will impact on germination.

Due to the vulnerability of canola's small seed it is recommended that unless it is harvested before any weather damage it should not be retained for sowing. Irrespective of availability, hybrid canola seed should never be retained for seed as the crop will not be true to the original first generation (F1) seed.

Any retained seed should be graded and tested for

germination and vigour. Testing for seed-borne disease is also recommended, especially with saved pulse seed.

Knowing the germination percentage at harvest will help determine how much extra seed may be required.

Assessing germination during storage will indicate potential problems, while a germination test prior to seeding will allow sowing rates to be adjusted.

## Wet seed at harvest

Weather damage occurs when grain is subjected to wetting at harvest. Generally, grain will absorb moisture and start the chemical process that eventuates in germination; this may be indicated by discolouration or wrinkled and loose seed coats, especially in pulses.

When pre-harvest moisture is significant the seed will swell, often splitting the skin covering the growing point. This seed is referred to as being 'sprung'. Once this has occurred the chemical reactions in the seed have greater access to oxygen and proceed at a faster rate.

If sufficient and prolonged moisture is available the embryo will grow and shoot, completing the germination process. But if moisture is lacking and the seed dries the process will be incomplete.

Provided the seed dries out before the embryo starts to grow this seed could still be viable for sowing.

Much of a sprung seed's energy store will have been used, greatly reducing the seed's ability to complete the germination process. Seeds will often be lighter and seedling vigour is often markedly reduced.

Germination causes an increase in alpha-amylase – an enzyme that breaks down starch. The longer the grain sprouts, the greater the amount of alpha-amylase formed. This is measured indirectly using the falling number test.

The falling number of badly sprouted wheat is about 62 seconds. High quality wheat gives a thicker paste, and the test then takes between 300 to 600 seconds.

Conditions that favour sprouting are also conducive to fungal growth.

Sprung seed is more susceptible to fungal attack and physical damage by handling. It is also more vulnerable to disease and rotting once sown.

## Harvest management

In wet harvests, when weather damage is occurring, it is important that retained seed is harvested as a priority but only at low moisture content. This is especially important where there is no aeration drying on-farm. If heat drying is used extreme care should be taken not to further damage seed quality.

Generally, harvesting at a moisture content of about one per cent below receival standard is considered appropriate.

Some pulse grains, particularly lupins, are very susceptible to damage if harvested at very low moisture content.

Where grain has swollen and then shrunk, seed coats will have been stretched and can become wrinkled and loose. The kernel of pulses can also become very brittle and break during handling.



Front and back images of wheat grains that are affected by pre-harvest sprouting. They have absorbed water and have started to germinate. Those showing embryo development – shoot and/or roots – will not be viable as seed.

(PHOTO: Dr J Barrero, CSIRO)



Harvester settings and handling processes must ensure that seed coats and kernels are not damaged. Damaged seeds will deteriorate rapidly.

Seed quality can also decline during storage. Testing seeds' germination capacity should occur before and during storage, and before seeding.

Generally, a germination percentage of 80 per cent at seeding is considered acceptable. When testing at harvest the germination percentage should be higher.

With many weedy pulse and cereal crops in a wet season, desiccation or crop topping often becomes necessary. Depending on timing and chemicals used, this could affect seed quality for sowing.

Grain must not be retained for seed when glyphosate has been used in pre-harvest applications.

## Storage

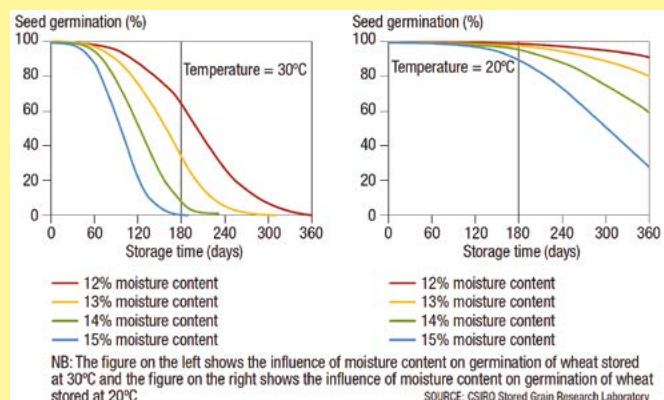
Achieving and maintaining low temperature, humidity and grain moisture content for stored grain is critical if grain has been weather damaged (Table 1). As weather damaged seed deteriorates faster than sound seed it should not be stored for more than 12 months (Figure 1).

**TABLE 1: Storage conditions required to maintain seed quality of key grain crops**

	Maximum temperature (°C)	Maximum moisture content (%)
Cereals	20	12
Canola	20	7
Pulses	20	12.5

SOURCE: GRDC Stored Grain Extension Project.

**FIGURE 1: Influence of storage temperature and moisture on seed vigour**



A germination test should be carried out on stored grain one to two months after storing to reassess its viability.

## Sowing

Weather damaged grain is likely to have a lower germination percentage and poorer vigour, so seeding rates will need to be adjusted accordingly.

A laboratory seed test should be used to establish the germination percentage of on-farm retained seed before sowing, especially if it has been weather damaged. A vigour test is also recommended.

Purchased seed will be certified and should include details of germination percentage.

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It is essential that nothing makes it harder for the germinating seed to reach the surface and establish.

Sowing too deeply, cold or wet soil, some seed dressings and herbicides and hard setting soil, can all reduce seedling emergence.

The coleoptile is a protective sheath surrounding the first leaf of cereals. This protects and guides the shoot as it grows through the soil. If the seed is sown deeper than the length of the coleoptile the plant can fail to emerge. Coleoptile lengths vary between varieties. For example, the wheat varieties Wyalkatchem

## IF YOU HAD A WET HARVEST, CHECK THE QUALITY OF RETAINED SEED

Heavy harvest rainfall could impact on the viability of grain that growers are planning to retain for sowing in 2018. Any grain subjected to wetting at harvest is more susceptible to poor germination, low vigour and degradation during storage and handling.

GRDC Southern Regional Panel member Kate Wilson encourages growers to closely scrutinise seed being set aside for planting. Kate, a grain grower and agronomic consultant in Victoria's Mallee, says it is essential that growers determine whether damage to grain caused by rain at harvest is purely cosmetic or the symptom of a seed-borne disease which will impact on germination.

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

She said growers should also be aware that some cereal varieties are more susceptible to the effects of late season weather damage.

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

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



GRDC Southern Region Panel member, Kate Wilson.  
(PHOTO: B Collis)

**FIGURE 2: Seeding rate calculation**

$$\text{Seed rate (kg/ha)} = \frac{\text{Target plant density (pl/m}^2\text{)} \times \text{100 seed weight (grams)} \times 1000}{\text{Germination percentage} \times \text{Establishment percentage}}$$

and Axe have moderately short coleoptile lengths, while Scout and Correll have moderately long coleoptiles.

The ideal seeding depth for wheat is 30 to 35 mm for semi-dwarf varieties, through to 50 to 70 mm for tall wheat varieties, which have a longer coleoptile length.

Barley has a shorter coleoptile length than wheat and so the ideal sowing depth is 20 to 30 mm.

Canola has small seeds and should be sown 12 to 25 mm deep. Poorer establishment occurs with smaller seed, therefore grade the retained seed and sow only the larger fraction.

Lupins should be sown no deeper than 30 to 50 mm depending on soil type and species. Other pulses tolerate sowing at depths of 50 to 80 mm but must be sown below the depth at which herbicides are incorporated.

Coleoptile lengths are shortened by some seed dressings and also from use of dinotroaniline herbicides (such as trifluralin, pendimethalin and oryzalin).

Seed dressings containing the fungicides fluquinconazole, flutriafol or triadimol, can all reduce coleoptile lengths under certain conditions.

These seed dressings should be avoided on weather damaged seed, particularly when used in conjunction with herbicides such as trifluralin.

Some new seed dressings contain the fungicide ipconazole, which has a reduced impact on coleoptile length, similar to triticonazole.

Care must be taken to sow the seed just below the herbicide layer and to avoid soil containing herbicide to be thrown into the furrow by the seeding implement.

Check with the supplier or manufacturer of seed dressings and chemical treatments to determine if they will reduce the coleoptile length or affect emergence.

## Seed testing

### Germination

While a laboratory seed test for germination should be carried out before seeding to calculate seeding rates (Figure 2), a simple on-farm test can be done in soil at harvest and during storage:

- Use a flat, shallow seeding tray (about 5 cm deep). Place a sheet of newspaper on the base to cover drainage holes and fill with clean sand, potting mix or freely draining soil. Ideally the test should be done indoors at a temperature of about 20°C or lower.
- Randomly count out 100 seeds, do not discard damaged ones and sow 10 rows of 10 seeds at the correct seeding depth. This can be achieved by placing the seed on the smoothed soil surface and pushing in with a pencil marked to the required depth. Cover with a little more sand/soil and water gently.
- Keep soil moist but not wet as overwatering will result in fungal growth and possible rotting.
- After seven to 10 days the majority of viable seeds will have emerged. Count only normal, healthy seedlings. If for example you count 78 normal vigorous seedlings the germination percentage is 78 per cent.



- While 80 per cent germination is considered acceptable for cereals and pulses, results above 90 per cent are required for canola. Certified canola seed is generally sold with 90 per cent germination.
- The results from a laboratory seed germination test should be used in the seeding rate calculation (Figure 2).

#### Disease

Grain retained for seed from a wet harvest is more likely to be infected with seed-borne disease. It is also more likely to suffer physical damage during handling, increasing the potential for disease.

Seed-borne disease generally cannot be identified from visual inspection, so requires laboratory testing. This is particularly important for seedborne diseases of pulses, for example blackspot (field peas) and aschochyta and botrytis (lentils, chickpeas, faba beans). Once a satisfactory germination percentage is known, seed should be tested for disease.

**Acknowledgements:** Allan Mayfield, Andrew Rice, Daryl Mares, Wayne Hawthorne, Don McCaffery, Trent Potter, Peter Botta.

**GRDC Factsheet: Retaining Seed** – [www.grdc.com.au](http://www.grdc.com.au)

## FREQUENTLY ASKED QUESTIONS

### *Can I retrieve and sow seed that is warehoused at a central grain receival site?*

It is only possible to retrieve grain from your farm if it has been warehoused. Retrieving warehoused grain will depend on each facility, store manager and variety licence owner.

Unless grain is delivered to a specific variety segregation, the grain is likely to have been mixed with multiple varieties of the same quality. It will also be mixed with weed seeds that may not all be present on your farm.

Sowing such a mixture of seed presents multiple agronomic problems, including mixed growing patterns, different disease resistances, different herbicide tolerances and uneven ripening. Marketing may also be a problem and details of market opportunities would need to be confirmed prior to sowing.

Retrieving warehoused grain is highly undesirable.

### *Is seed retained from previous harvests likely to be of better quality?*

The quality of retained seed that has been stored over several seasons will depend on its quality prior to storage and the storage conditions.

A pre-seeding germination test is essential for any seed sown after more than one season in storage. In some cases older seed may be better than seed from the current harvest. It may also be worse – remember that with pulses there were quality issues of low germination, seed size and vigour with seed harvested in 2009–10 due to the sharp seasonal finish. Seed-borne virus levels were also high.

### *Can I obtain better quality seed of the same variety from another grower?*

Growers cannot sell, trade, barter or give away seed of a variety protected by Plant Breeders Rights (PBR) for propagation unless they have an authorisation from the PBR owner of the variety. Any such authorisation is provided through a contract between the PBR owner or commercialising party and the grower.

# Preparation key to success with seed treatment

**P**OOR preparation and application are to blame for many grain growers achieving suboptimal results with on-farm seed treatments used to protect seed grain and crops against pest and disease attack.

That is the message from Western Australian-based GRDC Grain Storage Extension team member Ben White, who said that with all grain storage, preparation is the key to optimal results.

"Unfortunately we find that where treatments have failed, seed treatments have not been used well," he said.

"Common mistakes include treating seed that contains too much admix or poor product application methods."

Ben said if growers are considering the use of a seed treatment before on-farm storage, there are some simple steps that can be taken to protect the grain in storage, optimising germination results and crop vigour for next season.

"Most importantly, if growers don't have a gas-tight sealable silo meeting the Australian standard 2628-(2010), then consideration should be given to using a seed treatment with an insecticide component to protect seeds from insect attack while in storage," he said.

"Stand alone insecticide seed treatments compatible to mix with most desired fungicide packages are also available.

"Seed treatments should only be applied to clean seed, as excessive admix, or impurities like chaff and dust, contribute to poor product coverage. There are reputable professional services that will clean and treat your seed for you and, if unsure, it may be best to use these services."

The level of moisture in the seed is another important consideration, according to Ben.

"Monitor moisture content at harvest and plan to stay well below 12 per cent," he said.

"Seed treatments can also add between 0.5 and 1.5 per cent to moisture levels, depending on the application rate and water mix applied."

The method of application is the most important factor in achieving good results from seed treatment use.

"Before starting, measure the grain flow rate through the auger, as well as the flow-rate of the pump applying the seed treatment," Ben said.

"Adjust auger flow rate or seed treatment flow to match the desired application rate.

"Two spray nozzles spaced about one metre apart into the auger barrel typically deliver satisfactory and uniform coverage.

"If unsure, check with seed treatment supplier, as there are often useful resources and tips available to help achieve the best results with the product."



**Ben White.**

**More information about grain storage is also available at the GRDC Stored Grain Information Hub:** [www.storedgrain.com.au](http://www.storedgrain.com.au)



# Brian's dilemma

■ By Ian M. Johnston

I received a phone call the other day from my old bushy tailed mate, Brian.

You will note, I referred to Brian as 'old'. The reasons for this descriptive adjective are three fold. One – we have known each other for many years and shared numerous stimulating adventures with our classic cars. Two – he is one of these rare specimens of humanity that is actually older than me, but to be honest, only just! Three – I use the term as a definitive complimentary interpretation.

You see, when one achieves this golden epoch of senescent maturity, quite obviously one has acquired great wisdom and proficiency and can reflect fondly upon halcyon multifarious decades of joy and gaiety, particularly in our case, with the involvement of classic cars, plus (solely in my case) classic tractors.

## Brian's telephone call

The purpose of Brian's telephone call was to inform me of his dilemma and to seek soothing words of wisdom, as to his correct procedure in handling the perplexity of the problem.

I have already referred to Brian's interest in old classic cars. But in fact he harbours an affection for an assortment of old and historic artefacts, and this recently has extended to classic tractors. Being a gentleman fostering a vast store of information, he is well acquainted with the fact that in days of yore, the Massey Ferguson 35 could lay claim to being one of the world's most successful tractors, in terms of the numbers sold to farmers in numerous countries.

Accordingly, Brian decided it would be infinitely more appropriate for him to own a thoroughbred British classic tractor, and in particular an MF 35, for the purpose of tending his immaculate hobby farm acres, than the alternative of investing in a brightly coloured modern (possibly Chinese) small acre tractor, complete with all the complexities of high tech doo dahs!

So, what was the consternation responsible for Brian's dilemma? Simply that the MF 35, over a period was powered by three different basic power plants. He questioned which of these would represent the most impressive as a collectable artefact? For after all,

as Brian has established himself as a shrewd and adroit collector of classic vehicles, he therefore has a reputation to maintain!

## The Massey Ferguson 35

I felt obliged to point out to Brian (thus possibly confusing the issue) the fact that the MF 35 first saw the light of day in 1956 as a Ferguson 35. This was a replacement for the legendary Ferguson TE Series, or as it was popularly known around the world – The Little Grey Fergy.

The colour scheme of the Ferguson 35 was a bronzy gold, complemented by a grey bonnet and mudguards. But this livery was changed in 1957 to red and grey when Harry Ferguson sold his enterprise to the Canadian firm of Massey Harris, which gave emergence to the name initially of Massey Harris Ferguson, then simply Massey Ferguson.

But I digress. Returning to the question of engines, coming under the Massey Ferguson banner, it was logical for Brian to assume that all three engines would share a reputation of integrity. Yes, a natural assumption, one would conclude. But, regrettably such proved to be not the case!

Certainly the MF 35 Petrol engined version was an innocuous but not overly popular machine. It was equipped with the Standard designed four cylinder 34.5 belt hp engine. But farmers had attuned to diesel power, resulting in only a small percentage of MF 35 Petrol units being sold – the majority of buyers being hobby farmers who likely drove Volvos and considered diesel engines to be smelly.

Of interest to Brian was the fact that a first cousin of the MF 35 petrol engine also powered the Triumph 2000, plus the first of the TR series roadsters and the original Standard Vanguards.

In order to avoid a flurry of protesting letters, it is important I point out that many of the 35 petrol units were fitted with a lower compression cylinder head plus a 'hot box' attachment, enabling the tractor to run on low cost vapourised kerosene fuel. Plus there were standard and deluxe versions of the tractor,



Ferguson 35 Petrol. Restored by John Casey.



Massey Ferguson 35 showing the Perkins 152 diesel engine. (IMJ archives)



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**Fiat 411R, serious competition for the MF35. Restored by Greg Yarnold.**



**Allis Chalmers D270, a marketing failure. Restored by John Rutland.**

also vineyard and industrial variations. But I was anxious not to overburden Brian's grey cells with trivial information, so I remained silent on these nugatory considerations.

British built Ferguson tractors were manufactured for Harry Ferguson by Standard Motor Company in a factory located at Banner Lane on the outskirts of Coventry, which explains the association with Triumph and Standard vehicles. The plant was later acquired by Massey Ferguson, for the continued production of the 35 range, plus other models.

## The 23C

The original diesel engine fitted to the MF 35 was also a Standard product and designated the 23C. Frankly, I shudder when my thought process strays in the direction of the non-lamentable 23C.

I all too ably recall my days as General Manager of Cumberland Tractors, the firm credited with selling the greatest number of Massey Ferguson tractors in the Southern Hemisphere – the majority of these being MF 35s! Almost daily, semi trailer loads of MF 35s with their diesel 23C engines, arrived at our Auburn premises, direct from MF's Concord West factory in Sydney. On average 1 in 10 failed to start and required the expertise and some 'unconventional therapeutic' treatment by frustrated mechanics in order to coax the delinquent tractors into life.

Plus I cannot recall the number of service vans that were worn out prematurely, as a result of continually responding to warranty calls by angry farmers who had taken delivery of a diesel MF 35 powered by the 23C.

I acquainted Brian with the above information and, being a chap with a healthy inquiring mind, he requested I explicate to him the reasons behind the technical inaptitude of the four cylinder 23C.

Where to begin? I could explain to Brian such things as timing chain premature wear, ditto with pistons and valves. But the prime reason why the majority gave problems from day one, was the fact that the design of the indirect injection combustion chamber – coupled to a questionably high compression ratio of 20 to 1 – rendered the unit difficult to start from cold. This applied particularly in cool weather, and a lesser degree in warm climates.

Accordingly, my advice to my old friend was to not even consider an MF 35 powered by the four cylinder 23C. Particularly, with the passing of time, the situation would only have degenerated.

## The Perkins 152

Despite failing to publicly acknowledge the fact, Massey Ferguson knew they had a major problem on hand with the 23C.

In Australia, sales started to decline, mainly due to the growing popularity and reliability of the recently introduced Fiat Model 411R, which was being vigorously promoted by Fiat Australia as a direct challenge to the MF 35.

Back at Banner Lane a momentous decision was taken in 1958. Massey Ferguson acquired one of the world's most highly prestigious diesel engine manufacturers – F. Perkins Ltd. of Peterborough, England. A brilliant manoeuvre indeed, as this instantly provided MF with an entire range of modern, economical, high speed diesel engines.

Possibly the most outstanding and rugged of the Perkins range was the three cylinder D152 38.4 hp with a compression ratio of 17.4 to 1. This outstanding engine very quickly replaced by the four cylinder Standard 23C. Whilst not as silky smooth as the 23C, the D152 provided instant starting in even Arctic conditions and a considerably higher torque figure, which translated into a 6.150 pounds drawbar pull at 1.17 mph. An outstanding achievement for a lightweight tractor! The MF 35 had been virtually reborn.

The D152 engine proved so successful, that in various configurations it remained in MF tractors for several decades.

## No longer a dilemma for Brian

Brian is now totally relaxed about which MF 35 to purchase. In fact he was enticed to inspect an MF 35 just a couple of days ago. Apparently and quite remarkably the owner was unaware of which engine was in his tractor. Brian soon found out! With the aid of Aerostart the 23C (as it turned out) was eventually coaxed into life and proceeded to splutter and blast forth columns of putridity and evil smoke in such volumes, which undoubtedly caused acid rain to fall upon New Zealand the following day!

Brian is a patient chap and states he will happily await until a respectable Massey Ferguson 35, powered by the splendiferous Perkins D152, comes his way.

## Tail piece

The problem for Massey Ferguson with what to do with the remaining 23C engines was solved, when an astute salesman off-loaded the entire stock to the UK branch of the Allis Chalmers company. Anxious to include a British made diesel engine into its tractor range, a new model – the AC D270 – was released for both home and export markets.

Almost certainly due to the inherent inefficiencies of the 23C, it was a marketing flop, resulting in Allis Chalmers being forced to close down its UK manufacturing operation. ■



# Thirty years of *Helicoverpa* research in inland Australia

## PART 2 – THE MILLENNIUM DROUGHT

■ By Peter Gregg, University of New England

IN the first of these articles, published in the previous issue, I described the habitats and native host plants for *Helicoverpa* spp., especially *H. punctigera*, in inland Australia. Our knowledge of the ecology of these pests in the inland has come from a series of projects, funded by CRDC, GRDC and other agencies, over 30 years. But it has not been a continuous study.

From 1987 to 2000, we made 51 field trips to the inland, and from 2009 to 2017 we made another 39 such trips. So what happened between 2001 and 2008?

We never went to the inland, in part due to lack of funding, but also because it was extremely dry for most of this time.

### The Millennium Drought

The period between 2001 and 2009 is known to Australian climatologists as the Millennium Drought. While they differ on when the drought began (some consider it began with patchy rainfall from 1997 on), all agree it clearly ended with heavy rain during the summer of 2009–10. The Millennium Drought is generally regarded as the worst drought in recorded history for eastern Australia, with a return time estimated between 100 and 1500 years. Many growers will remember it as the 'mother of all droughts', drying up the dams to the extent that in 2007–08 cotton production fell to its lowest level in over 30 years, with only about 60,000 hectares planted.

While areas to the north and south of our inland study area had normal or even above average rainfall (Figure 1), in

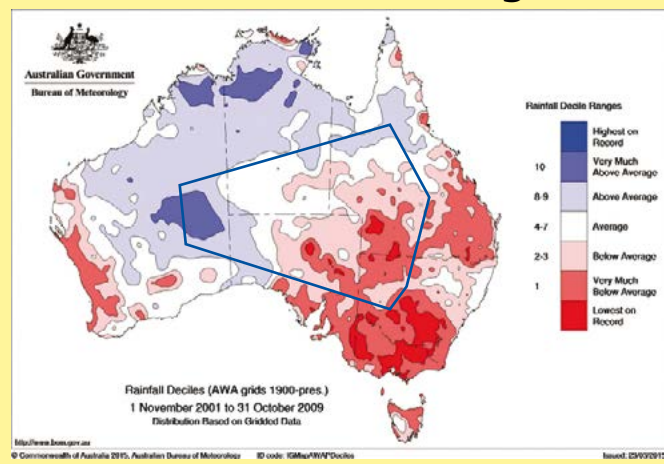


**PHOTO 1: The aftermath of the Millennium Drought in the mulga country, near Eromanga in western Queensland (May 2009). Note the death of large mulga trees and the complete lack of herbaceous vegetation between the mulga trees.**

the mulga country of southwest Queensland, the Millennium Drought was particularly severe. When we returned to this area in 2009 we were stunned by the difference in the vegetation. Many areas had no herbaceous vegetation at all, and in some places large mulga trees, which may have taken 100 years to grow, were dead (Photo 1). So what might this have meant for *Helicoverpa* ecology?

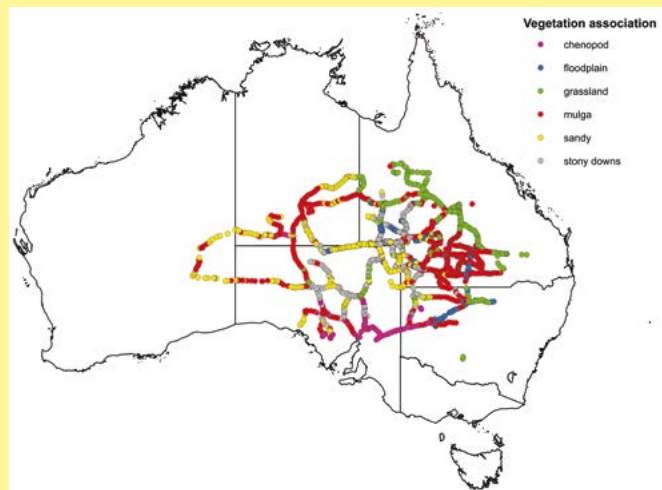
**FIGURE 1: Rainfall deciles 2001 to 2009 from the Bureau of Meteorology, with our inland study area indicated by blue lines. The Millennium Drought was most severe in eastern Australia, including the mulga regions of southwest Queensland.**

### The Millenium Drought



**PHOTO 2: Determining the vegetation association using an in-vehicle tablet computer running ArcMap with the South Australian Native Vegetation (Floristic) digital maps.**

**FIGURE 2: The distribution of vegetation assessment sites, showing our six major habitat classes**



## Vegetation assessment

Since 1987 we had been making assessments of the vegetation for the presence or absence of *Helicoverpa* hosts. We continued this in the post-drought years, aided by modern technology in the form of a GPS-enabled tablet computer running ArcMap, which allowed us to locate our position on vegetation maps produced by various state agencies (Photo 2).

At regular intervals (10 or 20 km) from waypoints such as cattle stations or road intersections, we walked a transect off the road, noting the general condition of the vegetation and the presence of host plants, recording the dominant host species and taking digital images. In this way we recorded vegetation conditions on almost 3600 sites (Figure 2).

## Changes in vegetation after the Millennium Drought

We have compared the proportion of sites occupied by host plants of different species, before and after the Millennium Drought, in each habitat. For three habitats we have found only minor differences:

- The saltbush country;

## INLAND HABITATS

We found that the vegetation classifications used by the various state agencies were too detailed and too inconsistent between states for our purposes, so we devised six broad habitat classifications based on the dominant vegetation or landforms.

The map (Figure 2) shows the distribution of these habitats, which are:

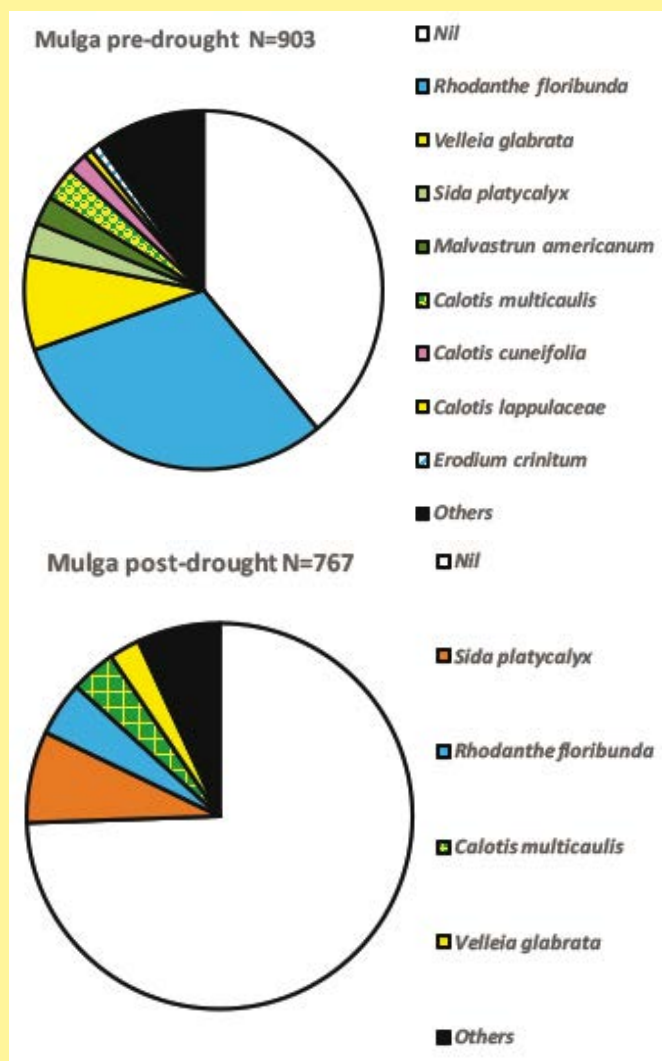
- **Chenopod shrublands:** Plants from the family Chenopodiaceae are common components of the vegetation throughout the study area. They include saltbushes, copper burrs and samphires, and they dominate the saltbush plains of western NSW and South Australia. While there are anecdotal reports of saltbushes being defoliated by caterpillars which sound a bit like *Helicoverpa*, we have never found larvae on these plants. But there are often medics and daisies, which are hosts, between the saltbush plants.
- **Floodplains:** In the southeast of the study area, the Darling, Warrego, Paroo and Bulloo rivers all drain into the Murray Darling system. These relatively narrow floodplains support a range of medics and daisies which are good *Helicoverpa* hosts, but they rarely support numbers like the broad floodplains of the Cooper, Diamantina and Eyre Creek/Georgina systems of western Queensland, which drain to the Lake Eyre basin. Here the hosts are other legumes, like the verbines (*Cullen* spp.) and daisies.
- **Sandy deserts:** The sandy deserts occupy the middle and western parts of our study area, and consist of sand dune/claypan systems like the Simpson Desert, and spinifex plains such as those in the Northern Territory. The sand dune/claypan areas generally support more host plants than the spinifex plains, and following autumn or winter rain the deserts can blossom with millions of hectares of good host plants like poached egg daisy and fleshy groundsel.
- **Stony downs:** The stony downs, such as Sturt's Stony Desert, are characterised by large areas of bare rock and shallow soils. They support succulents, chenopods and short grasses, all of which are poor hosts for *Helicoverpa* (with the possible exception of some succulents). Generally they form a mosaic between the floodplains and sandy deserts in the centre of

our study area, and they represent areas which migrating moths might have to cross before they find new areas suitable for breeding.

- **Grasslands:** The main grassland areas are the Mitchell grass plains of central Queensland in the northeast of our study area, but there are patches of grasslands, often with other grass species, throughout the region. Grasses do not support *H. punctigera*, and in seasons when there is good summer rain they can dominate the landscape, suppressing the growth of host plants such as daisies and legumes, even after they have dried out in autumn and winter. But as in the stony downs, we sometimes see small areas of hosts in creeklines and low drainage areas.
- **Acacia shrublands (mulga):** These areas border the sandy deserts and stony downs to the east, north and west. The dominant trees or shrubs are not always mulga, but include gidgee and other Acacia species. *Helicoverpa* host plants include daisies and other families, such as Malvaceae (the cotton family), Goodeniaceae and Solanaceae. Legumes are rare. The host plants of the mulga mostly respond to autumn and winter rain – as in other habitats, summer rain produces mostly grasses and perennials which are poor *Helicoverpa* hosts, or not hosts at all. The largest areas of mulga are mid southwest Queensland, and these have a special significance. They are the closest inland areas to our major cotton regions, and they might form a bridge for moths migrating from the floodplains and sandy deserts further west. The distance migrating moths can cover depends on the strength of the winds, especially high altitude nocturnal winds. Occasionally these might be strong enough to bring moths all the way from the inland. But modelling done by Wayne Rochester from the University of Queensland suggests that more often the nocturnal winds will deposit moths in the mulga, and it is their progeny that later invade cotton areas. So if there are few host plants in the mulga, there will be few spring immigrant moths in the cotton areas.



**FIGURE 3: Proportions of sampling sites in the mulga with various dominant host plant species for *Helicoverpa punctigera*, before and after the Millennium Drought**



- The sandy deserts; and,
- The floodplains.

In the saltbush country, 38 per cent of sites had hosts after the drought, compared to 45 per cent before the drought, and the most common dominant host were medics both before and after the drought.

In the sandy deserts, 59 per cent of sites had hosts after the drought compared to 67 per cent before, and the most common dominant hosts were daisies, especially poached egg daisies, and fleshy groundsel.

In the floodplains, 61 per cent of sites had hosts after the drought compared to 62 per cent before, and the most common dominant species were medics in the eastern floodplains and verbines in the western ones, both before and after the drought.

### Major changes in three habitats

In three habitats there were marked changes after the drought – the grasslands, stony downs and mulga.

In the grasslands, 25 per cent of sites had hosts after the drought compared to 49 per cent before the drought, and there was a marked reduction in the incidence of the verbines, which are good hosts.

In the stony downs, 21 per cent of sites had hosts after the drought compared with 22 per cent before the drought, and while this difference is not statistically significant, there was a striking lack of the daisy *Rhodanthe floribunda* (one of the best hosts) after the drought.

The mulga was the habitat that showed the greatest changes after the drought (Figure 3). It went from 61 per cent of sites supporting hosts prior to the drought, to only 25 per cent of sites with hosts after the drought.

Moreover, the hosts after the drought were generally poor ones such as *Sida platycalyx*. This plant is in the family Malvaceae, and goes by the endearing common name of ‘teddy bear’s bums’ (its seed capsule resembles a strategically placed button on old hand-made teddy bears, used to draw the stitching together).

But it is a poor host for *H. punctigera* and in many areas it has replaced good hosts such as the daisy *Rhodanthe floribunda*. The bottom line is that the mulga has become a much more hostile habitat for migrating *H. punctigera*.

### Why have the vegetation changes occurred?

A glance at Figure 1 will show that areas to the east of our study area were more severely affected by the Millennium Drought, especially the mulga of southwest Queensland. But it is now around eight years since the drought ended, and we have seen good rain in the inland in some of those eight years. So why have the host plants not returned? In part, the answer might be that the best rain (in 2010 and 2011) was in the summer, and this produces grasses and plants such as *Sida platycalyx* and copper burrs.

These do not support *H. punctigera* larvae, and even if they dry off in winter they still provide competition for the daisies and other good hosts. But in some years, especially 2016, we saw

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good winter rain. There were some areas of the western mulga that produced host plants in response, but many areas in the east did not (Photo 3). In these areas we suspect there has been seedbank depletion of the daisies.

Most daisies in the inland have seed dormancy mechanisms that prevent them from germinating in the summer, or in dry

winters, and these may carry them through a normal drought.

But in a protracted drought such as the Millennium Drought, many seeds might eventually die, and those that do not risk abortive germinations, where small falls of rain can germinate seeds but not allow them to get to flowering. In some areas the growth of the goat industry may have compounded these effects.

### What do the changes mean for *H. punctigera* in summer crop areas?

Long term trapping studies by Geoff Baker and Colin Tann (CSIRO) at Narrabri show that during and since the Millennium Drought there has been a marked reduction in the numbers of *H. punctigera* caught in pheromone traps, especially early in the season.

On the other hand, *H. armigera* numbers are down late in the season, a trend attributed by some researchers to the sink effect of Bollgard cotton, and we are seeing proportionately more *H. punctigera* in mid and late season. It is likely that the lack of early (September-October) *H. punctigera* is because migration from the inland to cropping areas of northern NSW and southern Queensland has become much more unreliable.

On the other hand, grain legume growers in South Australia and Victoria are still seeing large spring immigrations, at least in some years, and in the north we are still seeing *H. punctigera*, but later in the year. Where do these come from?

One possibility is that there is more local overwintering from those late season populations, perhaps because we are using less insecticide, but another is an alternative migration route that avoids the mulga.

This route might go from the far western inland (western SA and eastern WA which were not badly affected by the drought), south and east to the grain legume areas and to native hosts in the non-cropping regions of the western Riverina. Later in the season, when the weather has warmed enough to allow migration on winds from the south, the progeny of these moths might move back north to summer crop areas, causing our mid and late season *H. punctigera* outbreaks. But the existence of this migration pathway has not been proven.

### Implications for resistance management

In pre-Bollgard times, *H. armigera* became resistant to many insecticides but *H. punctigera* never sustained resistance to any insecticide, though transient resistance to some insecticides was occasionally reported. We think that this was because *H. punctigera* populations were renewed in most years through migration from the inland, which acted like a giant refuge.

In contrast, *H. armigera* overwintered locally and was thus subjected to constant selection pressure.

We thought the same factors would apply to Bt resistance, so it was a surprise when during the later years of the Millennium Drought it seemed that the frequency of resistant alleles in *H. punctigera* was increasing. This fitted with the idea that migration through the mulga had been reduced, but resistance has not continued to increase after the drought, even though host plants in the mulga have not recovered.

Perhaps we are now getting our susceptible *H. punctigera* from different areas, and perhaps northern growers should be grateful for all those winter legume crops in the south!

The long-term future of the mulga country remains unclear. For graziers, the mulga trees and the grass beneath them have largely recovered from the drought, and with the exception of the verbines, our host plants are not very important to graziers. It is likely that our plants will also eventually recover, but in some areas it may take decades.

It would be nice to think that another generation of entomologists will take another look, in another 30 years!



August 1992



August 2012



August 2017

**Photo 3: Changes in mulga vegetation near Eromanga, western Queensland. These photographs are taken at exactly the same spot, at the same time of year, over 25 years. The top photo shows abundant growth of the daisy *Rhodanthe floribunda*, a good host for *H. punctigera*, before the Millennium Drought. The middle photo shows the same area soon after the drought, following good summer rain that has left dry grass, copper burrs and *Sida platycalyx*, but no daisies. The bottom photo shows the same area after a dry period, with few annual plants of any kind.**





# NORTHERN FOCUS

COVERING NORTHERN NSW AND QUEENSLAND

## More rows, more mungbeans

■ By Cindy Benjamin and Neil Lyon, Grain Central

**R**ESearch trials continue to show that planting mungbeans on rows no wider than 50 cm apart will provide an average 10–12 per cent yield benefit.

In addition, there appears to be no detrimental effect on insect, disease or weed management, or on harvestability.

Queensland Department of Agriculture and Fisheries senior extension agronomist, Kerry McKenzie, Toowoomba, said that row spacings of 25 cm have given peak yields in all situations with all varieties in all seasons.

"We have had mungbean crops yielding up to 2.5 tonnes per hectare and down to 0.5 tonnes per hectare, but in all those situations it is the narrow rows that have given the best yields," he said.

Kerry said although it wasn't always practical for farmers to sow on rows as narrow as 25 cm, any reduction in row spacings would be beneficial.

"The peak yields have always come at 25 cm row spacing, but 50 cm is a good compromise. There is always a compromise in a farming system with what you can and can't do with things like machinery and stubble loads, so whatever you can do to get your rows closer together is going to give a yield increase," he said.

### Why are narrow rows best?

Kerry said with earlier work confirming that narrow row spacings produced higher yields, he was now looking into why those crops were yielding more and where that yield was coming from.

"We have trials looking at biomass production at 25 cm and 50 cm spacing, under irrigated and dryland systems, and how well that biomass converts to yield, or in other words, what is the harvest index," he said.

Kerry said time of sowing trials last year found a significant difference in yield for crops sown at the start of December, mid-January and the start of February.

"We got the best yields with the mid-January planting. Even though the third planting in February produced more biomass it didn't convert to extra yield," he said.

"I think one of the reasons is the February-planted crop was flowering in April and harvested in May when it ran into cool weather. A lot of the daily minimum temperatures were below 15 degrees and we weren't able to convert that extra biomass into yield."



Queensland DAF senior extension agronomist, Kerry McKenzie, Toowoomba, said that row spacings of 25 cm have given peak yields in all situations with all varieties in all seasons. (PHOTO: Neil Lyon, Grain Central)



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Provided the temperatures stay warm, mungbean crops are able to produce a harvest index of around 0.33 to 0.35 and don't appear to have a ceiling to the harvest index like chickpeas do. This means whatever a grower can do to increase biomass production will generate more yield.

High biomass crops are also known to compete strongly with weeds to suppress weed seed set and are less prone to powdery mildew. In addition, these high biomass crops fix more nitrogen, leaving more behind after harvest.

### Mungbeans and water use

To investigate where in the profile mungbean plants draw water from, Kerry is running trials with neutron probes in selected plots on 25 cm and one metre rows. There are two probes per plot looking at water extraction on the row and in the inter-row area.

"Last year we found that the 25 cm rows always yielded better and extracted slightly more water," he said. "In the one metre row spacing there was more water being extracted from the top layers in the inter-row than from the top layers in the row, down to about 50 cm. We think this water is being lost to evaporation from the soil surface in the wider inter-row."

One surprise finding has been that this fast growing crop is still extracting water from as deep as 105 cm in dryland and irrigated crops – much deeper than the 60 cm depth that had been previously thought.

Trials investigating plant population have confirmed that aiming to establish 20 to 30 plants per m<sup>2</sup> is still a good rule of thumb in dryland situations. But if there is a problem with establishment and the grower is left with an even stand of at least 10 plants per m<sup>2</sup> there is minimal loss of yield.

"When considering mungbeans in the rotation, keep in mind that mungbeans are susceptible to the main root-lesion nematode (RLN) species, *Pratylenchus thornei*, found in the northern region," said Kerry. "The mungbean crop does not suffer yield loss but, if present, nematode numbers will build up under the mungbean crop and may adversely affect the following crop."

RLN can cause yield losses as high as 70 per cent in intolerant varieties of wheat so growers are encouraged to test their soil for RLN and to factor this in when they are choosing wheat varieties for the following winter.

More information: [www.mungbean.org.au](http://www.mungbean.org.au)

## AUSTRALIAN MUNGBEANS IN DEMAND

Australian mungbeans are exported all around the world, finding their way to the most prestigious restaurants of New York City, to the bazaars of Pakistan and everywhere in between. Such a diverse market demands specialised marketing.

High prices over the past two years have caused increased production within many of the countries that are traditional markets for Australian product. As a result of increased supply, a correction in price for green mungbean has recently been experienced.

This correction in price is likely to see reduced production in some countries, which could easily change the world supply and demand position. Production in Myanmar is forecast to be down to 170,000 tonnes – almost half of their production last year – opening up opportunities in Australia's traditional Asian markets.

In June 2017, India introduced an import restriction of 300,000 tonnes of mungbeans per fiscal year (starting on the 1st April each year). But Australia is in a good position to be the preferred supplier for the Indian quota.

James Hunt of Australian Choice Exports is confident that prices will hold up, with demand looking good and prices are stable.

Stocks of the 2016–17 crop have been sold and with very little spring crop planted, demand is expected to be strong on the world markets when the Australian crop is harvested in March through to June. Demand is usually strongest during the Australian harvest period and can drop off slightly as other countries begin their harvest seasons.

### Reducing marketing risk

By working closely with an AMA member or marketer, growers can reduce their marketing risk and get the best value possible for their mungbean crop.

The large shiny green mungbean varieties such as Jade-AU and Crystal have taken Australia onto the world stage and will continue to dominate the Australian industry, providing high yield and reduced production risk.

AMA president Mark Schmidt said that while most growers



**The latest release black gram variety, Onyx-AU, is well-suited to sprout production. Around the world mungbeans are treated more as a vegetable than a grain, making hygienic practice essential throughout production, processing and storage.**

were familiar with these varieties, opportunities also exist for growing specialty mungbean varieties such as Celera II-AU, Satin II and the new black gram, Onyx-AU.

Celera II-AU is a small seeded variety that normally receives a premium over the large seeded varieties and has the best resistance to halo blight out of all current varieties.

Satin II is the preferred sprouting variety with established local and export markets. There is strong demand for high quality product meeting sprouter's specifications.

Black gram varieties Regur and Onyx-AU are well sought after in a whole range of markets from sprouting to processing for dhal. Onyx-AU has a yield advantage over Regur and is a direct replacement for this older variety.

As with all niche crops it is important to consult with your marketer prior to planting and establish the market requirements.

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# Debut of world first imi-tolerant grain sorghum

**A**USTRALIAN broadacre farmers will be among the first in the world to benefit from ground breaking new grain sorghum herbicide tolerance technology.

Following five years of development, Pacific Seeds will officially debut its new imidazolinone-tolerant grain sorghum line featuring its proprietary 'igrowth' trait at a series of field days across the summer cropping region from the end of January.

The igrowth trait is non-GMO (genetically modified), having been developed using conventional techniques.

Pacific Seeds Summer Grains and Forage Business Manager,

Andrew Short said what sets the trait apart from other attempts to incorporate imidazolinone tolerance into sorghum is its superior crop safety and agronomic performance.

"The igrowth trait offers sorghum growers the most robust form of imidazolinone tolerance in the market. Plant health issues associated with other imi-tolerance mechanisms often resulted in plant yellowing and a narrow window to apply the herbicide," he said. "igrowth has proven across years of field trials that when used as directed it offers true imidazolinone tolerance without the risk of crop damage.

"While imidazolinone-tolerant technology has been used in broadacre crops like corn, wheat, barley and canola for some time, this is the first time it will be available in grain sorghum anywhere in the world."

Andrew said trial results for the long-awaited technology will be showcased at the field days along with weed control benefits and management strategies to optimise crop performance.

"Our Toowoomba based sorghum breeding team has been instrumental to the development and testing of the world first igrowth herbicide tolerance, working closely with our research and development team in Argentina to ensure commercial reliability and efficacy for the Australian market," Andrew said.

The first commercially available igrowth hybrid for Australia will be Sentinel IG which will be available commercially in spring 2018.

igrowth grain sorghum hybrids will be launched in both Australia and Argentina simultaneously, with each geography incorporating the technology into their own locally bred and adapted hybrids.

"With Australia often being such a tough environment, it was



Pacific Seeds Summer Grains and Forage Business Manager, Andrew Short



The world's first imi-tolerant sorghum – Sentinel IG – is set for release in Australia this spring. Pittsworth (Qld) field trials during the 2017–18 summer indicate the benefits of the igrowth weed control trait.





# Centre pivot irrigation, precisely

■ By Jan Suszkiw, Agricultural Research Service – USDA

## AT A GLANCE...

- Centre pivot (CP) irrigation systems are popular, but they can over or under-water crops.
- Agricultural Research Service (USDA) wireless sensors aboard CPs gather current data on crop conditions.
- Decision-support system uses sensor data to guide precision irrigation.

The same Pittsworth trial crop on January 16, 2018 with the imi-tolerant sorghum on the left and control on the right.

vital for us to have this technology in germplasm specifically bred for Australian conditions,” Andrew said.

“Our comprehensive trials program has included Sentinel IG for a number of seasons now with it demonstrating excellent performance over multiple environments plus offering the added benefit of the igrowth weed control trait.

### Effective IWM critical for success

“But as with any herbicide tolerance system, effective integrated weed management is critical to the success of the crop.

“We hope to work with as many growers and agronomists as possible, as well as the broader industry, to ensure best practice introduction of Sentinel IG while preventing herbicide resistance development and ensuring this technology continues to benefit Australian farmers for long into the future.”

To further ensure optimal Australian performance and tolerance to broadleaf and grass weeds, Pacific Seeds worked in collaboration with BASF throughout trial work.

According to BASF broadacre portfolio manager for Australia and New Zealand Stuart McLaverty, Sentinel IG is the first summer crop on which BASF has conducted crop tolerance screening with Intervix.

“Following the crop tolerance screening, BASF has a high level of confidence in the technology and crop safety fit of the new variety,” Stuart said.

“Sentinel IG provides another management option for growers to produce a high yield of sorghum and an additional weed management system against weeds such as awnless barnyard grass.

“This project has only helped strengthen the already strong partnership between BASF and Pacific Seeds, paving the way for possible future collaborative efforts.”

With grain sorghum an important crop for both Australian farmers and Pacific Seeds, Andrew said the organisation is committed to furthering its investment in research and technologies that boost crop yields and improve grain quality and agronomic performance.

“As part of our breeding efforts we will be continuing to bring through more hybrids containing the igrowth trait to offer even greater choice and flexibility to growers,” Andrew said.

The use of Intervix on iGrowth herbicide tolerant sorghum is subject to the conditions of use in permit PER85318 issued 14/12/17 by the APVMA. ■

**H**IGH-SPEED wireless connectivity isn’t just convenient for cell phone and internet use anymore. It could also become key to automated methods that determine where, when, and how much to irrigate crops for optimal growth and yield.

In Bushland, Texas, Agricultural Research Service (ARS) scientists are testing a wireless sensor-based decision-support system that could help automated centre-pivot irrigation systems tailor water application rates to specific areas of a crop field – on the fly and using real-time data.

Known as Irrigation Scheduling Supervisory Control and Data Acquisition, or ISSCADA, the patented system will allow for “applying the right amount of water at the right time and in the right location in a field,” says Susan O’Shaughnessy, an agricultural engineer in the ARS Soil and Water Management Research Unit in Bushland.

Centre-pivot irrigation systems are used on 48 per cent of US irrigated cropland. The systems require minimal labour and are reliable, easy to operate, and conducive to remote operation



In a cotton field, ARS agricultural engineers Susan O’Shaughnessy (right) and Paul Colaizzi adjust commercial wireless infrared thermometers that measure plant leaf and soil temperatures. (PHOTO: John Blundell)





**Solar-powered soil water station in a corn field helps to prevent over and under irrigation of the variable-rate irrigation system. (PHOTO: Nancy Davis)**

and control, she adds. They can also be modified with the latest variable-rate irrigation (VRI) technology, offering a way to improve crop yields, conserve water, and reduce the cost of pumping it.

Typically, centre-pivot irrigation systems and other types of moving sprinkler systems apply uniform rates of water as they move around or across the crop field, says ARS agricultural engineer Paul Colaizzi. But considerable variability can exist not only in the field's terrain and soil composition, but also in the individual plants' water needs.

In regions where irrigation water is limited, farmers may seek to strike a balance by either spreading water over a large crop area, so the plants get just enough, or by concentrating it in a smaller crop area, so those plants are fully irrigated.

Applying too much water can encourage leaching of nutrients below the root zone, putting them beyond the plants' reach and closer to underground stores of water. Above ground, surplus water creates conditions for weeds and pests to thrive. Overwatered plants are prone to lodging and are more vulnerable to rot and other diseases. But given too little water, parched plants may succumb to heat stress and fall short of their expected yields, depriving farmers of a profitable harvest.

"Variable-rate irrigation can make it easier to spread water, without undue risk of under-watering, or to concentrate water, with less risk of over-watering," says Susan.

### **Other practical barriers to adoption**

Although VRI technology is commercially available, there are still costs, learning curves, and other issues associated with adopting it, the researchers note.

"These barriers include the need for high-speed rural internet and cellular service, advanced soil-plant-atmosphere models, appropriate decision-support systems, sufficiently powerful hand-held computers, and wireless sensors that can survive harsh field conditions," says Susan. "These have been perhaps the most intractable technical barriers so far."

The Bushland team's ISSCADA system is the culmination of a multifaceted effort to overcome those hurdles. The team's efforts

include not only the development of new, wireless soil-water sensors and plant-canopy thermometers, but also mathematical algorithms.

Using data acquired from the sensors, the algorithms create daily crop-stress indices and threshold levels that can be integrated with colour-coded, geographic information system (GIS) maps. The GIS maps show where, when, and how much farmers should irrigate – or if they should withhold irrigation.

In field trials with corn, cotton, sorghum, and soybeans, ISSCADA-controlled centre-pivot irrigators performed as well as irrigators that had been manually programed by the team. Tests of ISSCADA under different conditions are also under way at ARS sites in Portageville, Missouri; Stoneville, Mississippi; and Florence, South Carolina.

### **Industry collaboration**

The researchers are collaborating with three companies (Valmont, Dynamax, and Acclima) to refine the irrigation-scheduling system they've developed and integrate it with existing VRI systems. Under a cooperative research and development agreement, "we are developing a client/server software package that integrates the sensor network systems with VRI hardware so that a farmer can easily use the system for precision irrigation," says Susan. A grant from the USDA National Institute of Food and Agriculture also funds this work.

Paul Colaizzi expects this capability to become especially important, given the increasing off-farm competition for water for residential, recreational, municipal, and other uses.

At the end of the day, it's all about having the right tools on hand to make the best decisions possible, the researchers note.

"As long as we're growing crops and have to eat, water will be one of the main variables to be managed – whether it's 'more crop per drop or less drop per crop,'" says Paul.

**More information:** Susan O'Shaughnessy, Soil and Water Management Research, Agricultural Engineering, Bushland Texas.

Email: Susan.OShaughnessy@ars.usda.gov  
Phone: +1 806 356 5770.



# Off-target spray drift – managing impacted crops

■ By Cotton Seed Distributors and Graham Charles , NSW DPI

**U**NFORTUNATELY, and far too often, a recurring issue for cotton and grain growers is the impact of off-target spray drift on crops. This season, there are areas which have medium to severe damage across multiple fields, and in many cases every plant has signs of damage. The impact of the off-target spray drift has been devastating to cotton growers, and particularly bad for those who have limited options to enable crops to recover.

These damaged crops have no boll load and most squares have aborted. In this worst case scenario, the plant will not die but the estimated time to recoup the fruit means some of these crops will likely be abandoned.

Cotton is extremely sensitive to phenoxy herbicides such as 2,4-D. The degree of damage is proportional to the amount of herbicide drifted onto the plant and the stage of growth of the cotton plant. Most plants that have even the smallest amount of chemical taken up will show leaf symptoms after a period of time. Leaf symptoms can show as early as one to three weeks after direct applied or nearby drift events, while inversion events can take three to five weeks to show up in crops.

Time, water and fertiliser are the only way to help recoup what has been lost.

Graham Charles, Research Agronomist and Weed Scientist from NSW Department of Primary Industries has provided the following insights into the management options available for growers to offset some of the damage caused by off-target spray drift on cotton crops.

## 2,4-D damage at 12 and 16 node cotton

Generally, the earlier the crop has been affected, the more damage or delay in maturity will occur – similar to if we were spraying weeds where the smaller weeds are more susceptible. Our research has shown that exposure to one per cent (12.5 ml per hectare 2,4-D Amine 625) of the normal commercial applied rate (the crop sprayed at one per cent in order to replicate a drift or inversion event at 12 nodes), can have a devastating affect on young cotton plants (Table 1).

Apart from the direct fruit loss caused by 2,4-D drift, the ongoing impact of 2,4-D drift on crop leaf area may reduce photosynthesis and carbohydrate supply to emerging fruit. The crop will compensate to the loss of fruit by putting on more fruiting nodes, but as a consequence this extends the growing season with the delay in crop maturity being close to a month or 27 days.

Bolls per metre and boll weight were both impacted as the

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**TABLE 1: The impact of one per cent (12.5 ml per hectare) of the normal commercial applied rate 2,4-D Amine 625 on 12 node cotton**

	Undamaged comparison	2,4-D 1% @ 12 nodes
Nodes/plant	25.0	28.6
Leaves/m*	526	1006
Leaf area (cm <sup>2</sup> /m)*	22,302	16,512
Reduction in leaf area*		26%
Bolls/m	188	98
Boll weight (g/open boll)	4.6	4.2
Retention position 1–3 <sup>^</sup>	92%	81%
Nodes carrying >80% bolls <sup>#</sup>	9–19	7–21
Days to 50% open	152	179
Maturity delay (days)		27
% Open bolls at picking	99%	56%
Lint yield (kg/ha)	1631	508

\* These parameters were last recorded 131 days after planting.

<sup>^</sup> Percentage of retained bolls in positions 1–3.

<sup>#</sup> The spread of nodes carrying more than 80% of open bolls.

Source: Graham Charles, NSW DPI, 2015.

crop tried to create a top crop in the autumn months. In this example, a grower must decide whether it is worth giving more resources to this crop, and whether there is enough time left in the season left for the crop to compensate for the damage that has occurred.

The research suggests even greater impacts on yield and maturity would occur if the inversion/drift event delivered more than one per cent concentration on 12 node cotton. For example, at 10 per cent (128 ml per hectare 2,4-D Amine 625) the delay could be over 50 days with an 85 per cent hit on yield.

As the cotton plant gets bigger, it is more able to tolerate a spray drift event. At 16 nodes, the plant has started flowering,

**TABLE 2: The impact of 10 per cent (128 ml per hectare) of the normal commercial applied rate 2,4-D Amine 625 on 16 node cotton**

	Undamaged comparison	2,4-D 10% @ 16 nodes
Nodes/plant	25.0	28.2
Leaves/m*	526	759
Leaf area (cm <sup>2</sup> /m)*	22,302	23,203
Reduction in leaf area*		—
Bolls/m	188	126
Boll weight (g/open boll)	4.6	4.1
Retention position 1–3 <sup>^</sup>	92%	94%
Nodes carrying >80% bolls <sup>#</sup>	9–19	8–16
Days to 50% open	152	155
Maturity delay (days)		3
% Open bolls at picking	99%	86%
Lint yield (kg/ha)	1631	1073

\* These parameters were last recorded 131 days after planting.

<sup>^</sup> Percentage of retained bolls in positions 1–3.

<sup>#</sup> The spread of nodes carrying more than 80% of open bolls.

Source: Graham Charles, NSW DPI, 2015.

has a good root system and larger biomass. The same one per cent (12.5 ml per hectare 2,4-D Amine 625) drift on the 16 node cotton has little effect on the physiological processes, but leaf distortion symptoms are still obvious on new growth. There is no major delay in maturity and boll weights are similar to an undamaged plant. There is a slight decrease in yield of seven per cent with lower boll numbers.

If the drift event was 10 per cent (128 ml per hectare 2,4-D Amine 625) of the recommended commercial applied rate on 16 node cotton, the impact is harsher (Table 2), with more leaf damage in new growth, bolls per metre are down by 33 per cent and boll weight is down by 11 per cent. There is also a delay of three days in maturity but this could blow out, depending on the crop.

The impact of higher concentration drift/inversion has a massive impact on yield. The crop aborts all new squares and puts on more fruiting branches to try and compensate for the damage. The time taken to recoup aborted squares and fruit prolongs the season.

A cotton plant past 20–25 nodes and well into flowering, if drifted upon (dependent on how much concentration of product in the drift), will hold most of the set bolls on the plant, but the new leaf will still show signs of the drift event.

These top fruiting nodes typically produce lighter bolls which if aborted will cause some yield loss but not to the extent of a younger plant with spray drift.

### What can I do if a drift event occurs?

It is very important to understand where the crop is up to in terms of nodes, bolls and squares. The younger the crop the more the damage will set the crop back and even though drift events and inversion very seldom kill the plant, the delay with fruit set and boll development and maturity may warrant the crop being abandoned. Defoliation can also be very difficult as the leaf petiole abscission can be affected by spray drift, as the leaf takes a long time to drop, and sometimes won't come off.

#### A checklist of things to do:

- Notify your agronomist, neighbours and Cotton Australia.
- Identify direction of drift and chemical that has damaged the crop.
- Assess damage on a field by field basis, nodes and fruiting structures.
- Monitor the crop over a period of time to see whether the damage is continuing and look at new growth for further leaf distortion.
- Make a decision on young crops as to whether they will have time to recover. If not, reallocate resources into the more mature crops.
- Be prepared to use growth control on some crops if retention is poor.
- Manage retained crops as normal with water and nutrition without further stress events.
- If the crop is past last effective flower date, a decision must be made to determine how late to let the crop grow out. An extra five fruiting nodes can increase crop maturity by 15–25 days depending on the finish of the season.
- At defoliation, use slightly higher rates of defoliant and be prepared to wait longer for the leaf to fall.
- Notify the gin of your circumstances and get the cotton ginned as soon as possible.

For more information on the impacts of spray drift on cotton please refer to: [www.cottoninfo.com.au/publications/weedpak-herbicide-damage-id-guide](http://www.cottoninfo.com.au/publications/weedpak-herbicide-damage-id-guide)

For further information in relation to any of the topics mentioned in this article:

Contact Graham Charles at ACRI on 02 6799 1524.

Contact your local CSD Extension and Development Agronomist.

Visit the CSD website ([www.csd.net.au](http://www.csd.net.au)).



# SOUTHERN AUSTRALIA FOCUS

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## ASK AN EXPERT – HOW CAN I USE PASTURE PHASES TO BEAT HERBICIDE RESISTANT WEEDS?

■ With Tim Condon, Senior Consultant, Delta Agribusiness

**C**ROPPING a thousand hectares with a low weed seed bank is worth at least \$20,000 per year. Including a pasture or fodder phase can help achieve this while revving up the whole farming system.

Delta Agribusiness senior consultant, Tim Condon says the reason for including a pasture phase is one of the WeedSmart 'Big 6' tactics to manage herbicide resistance is the opportunity it provides to drive down weed seed numbers before returning to a cropping phase.

"The key is to always go into the crop phase with low weed numbers and also go into the pasture phase with low numbers," he says. "The idea that pastures are an effective 'reset' after a weed blow out doesn't always work."

What does work is taking a planned approach right across the pasture phase and using a number of tactics known to be highly effective at preventing seed set. Several of the tactics available for use in a pasture phase can provide over 90 per cent control of the target weeds.

The plan needs to outline how the pasture phase will fit into the crop rotation and what tactics will be used seasonally and rotationally to maximise the effect on weed numbers.

### **Aim for dense, persistent and nodulating pastures**

"The aim of the game is to establish dense, persistent and nodulating pastures," says Tim. "Pastures offer the opportunity to have two to three consecutive years of no seed set. Go into the



**Tim Condon, Delta Agribusiness says adding a two to three year pasture phase provides growers with a number of additional weed control tactics to address herbicide resistance.**

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**For a pasture phase to be an effective weed control measure the pasture must be persistent, nodulating and dense.**

pasture phase with a clear plan for weed control and avoid the temptation in a tough winter to 'drop the weed control program – because you need the feed'."

Tim recommends incorporating fodder crops or short-term pastures for grazing as well as fodder conservation. The livestock options are flexible and can include running a livestock enterprise, buying in or agisting livestock for short-term grazing.

"Having livestock in the system can also influence your choice of other weed control tactics such as harvest weed seed control – where you can use the chaff dumps or chaff lines as an additional feed source," he says. "Using heavy strategic grazing after applying glyphosate and prior to a double knock dose of gramoxone is also a very effective tool"

The weed control tactics that offer the greatest seed set prevention in pastures are hard winter clean, hay and silage. Using as many tactics as possible each year helps to target different weeds with both herbicide and non-herbicide control measures.

Two or three years of pasture also pays dividends with improvements in soil tilth, fertility and water infiltration as a result of growing persistent, nodulating, dense pastures.

### **What is the most effective winter clean tactic?**

**Short answer:** A hard winter clean.

**Longer answer:** A hard winter clean is hard on the desirable perennials and annual legumes but very effective on weeds. If you choose to use a soft winter clean to preserve the legumes, be sure to follow up with another tactic.



**A hard winter clean is the most effective way to end a pasture phase and to maximise the chances of re-entering the cropping phase with very low weed numbers.**

For a hard winter clean to be most effective the pasture must be grazed very short prior to spraying. If there are patches of long vegetation or different weed species, consider spraying these areas separately, or twice, with the most effective chemicals. You can target both annual grasses and broadleaf weeds, but choose the herbicide mixing partners carefully.

### **What other tactics can be used?**

**Short answer:** Spray topping.

**Longer answer:** Spray topping with either glyphosate or gramoxone early in the pasture phase can be used to start the process of driving down the weed seed bank. Timing is critical. For example, paraquat must be sprayed at flowering while glyphosate has a wider window of growth stages and can be more effective across a range of species at a single given application timing. Of course, a complete and timely spray fallow in the last year of the pasture phase is a critical part of the process. Often a double knock with glyphosate followed by gramoxone can be employed to achieve 100 per cent control.

### **What are the keys to growing dense, persistent and nodulating pastures?**

**Short answer:** Attention to every detail!

**Longer answer:** A pasture phase is a good time to analyse the soil and take action to correct any acidity or other nutrient constraints. Zero or minimum tillage systems can lead to pH and nutrient stratification with sub-surface layers remaining acidic. Sampling and testing the 5–10 cm layer will identify if this is a problem. This is an ideal time to consider strategic tillage if this is an issue.

Decide on whether to establish the pasture with a cover crop or by direct seeding – both have pros and cons. Direct seeding is the best choice if the pasture mix includes a short term legume species or is grass-based in drier environments.

If you choose to establish the pasture under a cover crop, the pasture must win this competition. Choose a crop that can be sown early and sow the crop in a north south direction at a low seeding rate. Remember that it is all about giving the pasture the competitive edge. Choose pasture species that are suited to your area and are weed suppressive.

### **What fodder conservation measures provide the best weed control?**

**Short answer:** Both hay and silage are great for preventing seed set.

**Longer answer:** Using a combination of tactics works well. Silage is cut earlier in the season – so crash grazing after cutting followed by a spray fallow is highly effective. As is a pre-cutting application of glyphosate, particularly with hay making. ■

## **HOW TO ASK A WEEDSMART QUESTION**

Ask your questions about building a pasture phase into your cropping system on the WeedSmart Innovations Facebook page WeedSmartAU, 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.



# Willow-leaved lettuce glyphosate resistance confirmed

**T**WO populations of the broadleaf weed willow-leaved lettuce (*Lactuca saligna*) have been confirmed to be resistant to the key herbicide, glyphosate, in vegetable production in Western Australia.

Willow-leaved lettuce, also known as wild lettuce, has increased in abundance during the past 10 years. This is largely due to a widespread shift in the industry to glyphosate-based weed control. The resistance was confirmed in a commercial horticulture crop in the Gascoyne irrigation area.

Western Australian Department of Primary Industries and Regional Development principal research officer Abul Hashem, who is a member of the Australian Glyphosate Sustainability Working Group, said the discovery was of immediate concern to the irrigated agriculture industry but was also relevant to other sectors including the grains industry.

"This is another unwanted world-first for Australia and is the seventh glyphosate-resistant broadleaf weed species to be confirmed in Australia," Abul said.

"Willow-leaved lettuce joins its close relative, prickly lettuce, populations of which were confirmed to be resistant to glyphosate in 2014."

Willow-leaved lettuce, an annual-to-biennial, warm season weed found in disturbed areas, roadsides, channel banks, fence lines and horticultural crops, is from the daisy (*Asteraceae*) family. It has the potential to move into cropping paddocks due to its wind-blown seed.

"While the actual level of glyphosate resistance is quite low, at double that of susceptible populations, experience with sowthistle (*Sonchus oleraceus*) in New South Wales shows low level glyphosate resistance is enough to result in significant increases in weed numbers in paddocks being treated with glyphosate alone," Abul said.

"The mature seed of this weed can be dispersed by wind over a long distance so the resistant gene could spread into cropping

paddocks and establish within a short period of time when glyphosate fails to control this weed."

## Best management strategies

Management strategies to reduce the risk of herbicide resistance in willow-leaved lettuce include using robust rates of glyphosate, improving spray application techniques, double knocking with another herbicide with a different mode of action or cultivation and using robust tank-mixes with both herbicides effective on the target species.

"The discovery of glyphosate resistant willow-leaved lettuce in vegetable production shows that no sector of agriculture is immune to glyphosate resistance, if glyphosate is the main weed control strategy," Abul said. "Growers need to be on the lookout for weeds surviving herbicide applications and stop them from setting fertile seed."

The Australian Glyphosate Sustainability Working Group is supported by the Grains Research and Development Corporation (GRDC) and key research and development based crop protection companies, with an interest in the sustainability of glyphosate. The group has a range of information about glyphosate resistance, including a register of glyphosate resistant weed populations and guides and links to details about the management of glyphosate resistance in different crops and management situations on its website at [www.glyphosateresistance.org.au](http://www.glyphosateresistance.org.au).

For more information on the sustainable use of herbicides visit the WeedSmart information hub [www.weedsmart.org.au](http://www.weedsmart.org.au)



Willow-leaved or wild lettuce (*Lactuca saligna*) on a channel bank with sowthistle (*Sonchus oleraceus*) at Carnarvon, WA. (PHOTO: John Stretch, DPIRD)



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# Manage the greenbridge to reduce Russian wheat aphid risk

**E**FFECTIVE management of the 'green bridge' over the coming months will place grain growers on the front foot in their efforts to control Russian wheat aphid (RWA) in 2018.

Eliminating the green bridge – volunteer cereals and weeds – well ahead of sowing this year's winter crops will reduce RWA host plants and thereby minimise the risk of crop infestation.

Crop pest experts, supported by the GRDC, say RWA establishes most successfully where there is a continual green bridge of host plants over the summer/autumn period. These host plants allow RWA populations to persist from one growing season to the next.

Green bridge control is therefore a key element of an overall RWA integrated management strategy that growers are encouraged to implement this year.

## At least a month prior to sowing

Entomologist Maarten van Helden, from the South Australian Research and Development Institute (SARDI), says it is important that growers remove all volunteer cereals and weeds at least four weeks before sowing this year's winter crops.

Maarten, who has contributed to development of the GRDC's new *GrowNotes RWA Tips and Tactics* publication (now available at <https://grdc.com.au/TT-RWA>), says green bridge control at least a month before sowing will drive down over-summering populations of RWA well in advance of crop emergence.

"Paddocks kept bare – either by spraying, cultivating or heavy grazing – for at least a month prior to sowing will protect crops from early infestation of RWA, enabling better establishment," Maarten says.

Maarten, who has been involved in GRDC research investments since RWA was first discovered in Australia in 2016, warns that RWA infestation is more likely in early-sown crops and that this should be factored into consideration by those growers who are increasingly electing to sow early for agronomic reasons.

He also recommends avoiding sowing crops into paddocks near areas where alternate RWA host plants are growing but cannot be eliminated.

The *GrowNotes RWA Tips and Tactics* publication states that use of neonicotinoid seed treatments for early-season control of RWA should be targeted only at those situations deemed to be of higher risk, such as early sowing (especially early-sown barley crops) or areas where volunteer cereals and/or live aphids are identified prior to sowing. Prophylactic use of neonicotinoid seed treatments is discouraged.

Now present in areas of SA, Victoria, Tasmania and southern New South Wales, RWA has been the focus of several GRDC research investment undertakings which are providing the Australian grains industry with greater understanding of the pest and its potential impact, to inform management strategies, including the 'FITE' strategy which has been developed to provide growers and advisers with a simple guide to management.

## The FITE strategy

Outlined in the new *Tips and Tactics* publication, the FITE (find, identify, threshold approach and enact) strategy involves:

- Find – Look for aphids and the characteristic plant symptoms of infection including leaf streaking or leaf rolling on cereal crops and grasses;
- Identify – Positively identify RWA by consulting with an industry specialist;
- Threshold approach – Before deciding on your plan of attack consider thresholds for control, the presence of natural aphid enemies in the crop, crop growth stage and potential yield losses; and,
- Enact – Take appropriate action: Manage your next steps including encouraging beneficial insects and protecting honeybees before implementing control options.

Last year, Maarten and other scientists confirmed that the RWA now established throughout parts of the nation's south-eastern cropping regions is a single biotype (having the same genetic make-up).

This new knowledge, achieved through research investments by the GRDC, will underpin ongoing and future research efforts aimed at combating the cereal crop pest.

In addition to experiments to determine aphid biotype, the GRDC has been investing in research to confirm susceptibility of commercial wheat and barley cultivars to RWA; assessing potential sources of plant resistance; RWA biology, ecology and economic thresholds under Australian conditions; an investigation into alternate hosts for RWA; trials looking at insecticide efficacy; and development of practical resources for growers and advisers.

While plant resistance has been deployed as a management strategy in areas of the world where RWA is a serious risk, the aphid has responded through the evolution of new biotypes attacking these resistant plants.

The GRDC is therefore emphasising that genetic plant resistance will not be "the solution" to RWA control, but it will form part of an integrated pest management strategy that includes green bridge management, agronomic practices, strategic use of insecticides, and exploitation of natural enemies of the pest.

**Suspected new infestations of RWA should be reported to the Exotic Plant Pest Hotline on 1800 084 881.**



**SARDI entomologist Maarten van Helden, pictured in a RWA research plot, says it is important that growers remove all volunteer cereals and weeds at least four weeks before sowing this year's winter crops.**



# New high protein lupin variety

**A** NEW high protein lupin that has superior tolerance to the herbicide metribuzin was launched at the Mingenew Irwin Group Field Day in Western Australia on September 6, 2017. PBA Leeman is a high yielding narrow leaf lupin suited to an area stretching from the Northern Agricultural Region through to the Lakes District in the south.

The variety's commercial title continues the relatively new tradition of naming lupin varieties after coastal towns close to the environments to which they are suited.

PBA Leeman was developed by Department of Primary Industries and Regional Development (DPIRD) through the national Pulse Breeding Australia (PBA) lupin breeding program, with Grains Research and Development Corporation (GRDC) investment.

Department senior plant breeder Jonathan Clements said the new variety would interest lupin growers targeting the high protein feed and aquaculture niche markets.

Jonathan said PBA Leeman was comparable to the popular variety Coromup (see Figure 1).

"PBA Leeman is an early maturing, early flowering sweet lupin variety that produces competitive yields, which are similar to or better than Coromup, a variety from 2006, which is still sown in Western Australia," he said.

"The variety has a protein value of approximately 35.4 per cent, which is on average 0.6 per cent higher than Coromup."

PBA Leeman is a robust lupin variety, with good pest and disease tolerance and superior tolerance to the herbicide metribuzin.

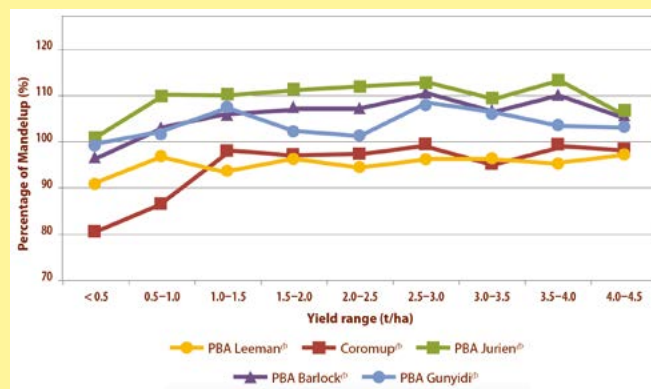
"Its tolerance to metribuzin will make it a desirable variety for growers with weed management challenges," Jonathan said.

"The variety also has good resistance to the fungal diseases phomopsis, anthracnose, grey spot and aphids, with moderate levels of susceptibility to viruses."

Seednet has been licenced to distribute PBA Leeman, which is subject to Plant Breeder's Rights, and is currently being bulked up for commercial availability prior to the 2018 season.

The variety is one of the final two lupin varieties bred by the

**FIGURE 1: Relative performance of PBA Leeman as a percentage of Mandelup across WA sites of similar mean site yields**



department, as part of the Pulse Breeding Australia's national lupin breeding program.

The department has released about 30 lupin varieties since 1973, with early lupin varieties paving the way for the national development of the industry.

Contemporary varieties, developed with long term investments by the GRDC, now underpin the productivity and sustainability of farming systems on sandy acid soil types.

Plant breeding company Australian Grain Technologies (AGT) will continue to undertake commercial lupin breeding in WA through germplasm licensing arrangements established with DPIRD and GRDC in 2015.

The department will continue pre-breeding genetics research to identify disease, quality traits and agronomic performance traits in narrow leaf lupins.

More information about PBA Leeman can be found on the GRDC and Pulse Breeding Australia websites.



**DPIRD officers (from left) Dr Jonathan Clements, Cliff Staples, Daniel Renshaw and Dr Hua'an Yang with the newly released lupin variety PBA Leeman.**

# New technology assists canola growers with late flush of weeds

**N**EW technology allowing growers to spray canola with glyphosate later in the season will be a valuable option for Andrew Morrison, of 'Woolbrook', Teesdale, west of Geelong.

Andrew said they had been growing Roundup Ready canola with great success since it was first launched and the introduction of TruFlex canola – which is planned for release in 2019 – will provide more flexibility.

"We get some late radish and late ryegrass germinating," he said, "so it would be advantageous to have a later spray. TruFlex canola, coming in a couple of years, may give us that opportunity."

Currently Roundup Ready herbicide with Plantshield by Monsanto is limited to two applications over Roundup Ready canola at 0.9 kg per hectare at or before the six-leaf stage of the canola crop.

## Higher rates and later in the season

In 2019 Monsanto plans to release TruFlex canola, which has the advantage of higher rates of Roundup Ready herbicide with Plantshield that can also be applied later in the season.

Growers will be able to spray three times with the current rate at 0.9 kg per hectare or they can opt for a two-spray strategy at a higher rate of 1.3 kg per hectare.

Roundup Ready herbicide with Plantshield can also be applied up until first flower.



**Andrew Morrison, of 'Woolbrook', Teesdale, has had great success with Roundup Ready canola over many years and is looking forward to the 2019 release of TruFlex canola.**

Andrew said Roundup Ready canola was a critical part of their program and produced better weed control than other options.

He said their continuous cropping program has lasted for 30 years and he currently rotates between canola, wheat and barley.

Just prior to the introduction of Roundup Ready canola, the property was developing issues with grass selective herbicides.

We'd got to the situation where we couldn't control the ryegrass and it was becoming very difficult. We were on the verge of having to go back to pasture.

"We were busting for Roundup Ready canola to come along and so that ended up being our saviour."

In 2008 the Woolbrook property hosted a large-scale trial site of Roundup Ready canola as part of the first commercial release of the technology.

"It was a great demonstration site and it worked really well. We had thousands of people come to have a look and it was a good experience," Andrew said.

## Dirtiest paddocks were "cleaned up beautifully"

The next season Roundup Ready canola was grown in the oldest paddocks that had the most difficult ryegrass resistance problems.

"We had a fantastic result with them. It cleaned them up beautifully and they were clean as clean."

That season triazine-tolerant canola was grown in the newer paddocks and the herbicide did not provide the control that had been hoped for.

"They ended up being very dirty, even though they were the cleaner fields, so we suffered from that in the following years," Andrew said.

That season was a reasonably tight year in terms of rainfall, and the Roundup Ready canola yields were 20 to 40 per cent higher with oil content three per cent better than the triazine-tolerant canola.

"With the paddocks we cleaned up with Roundup Ready canola, we were back in the game for cropping and have been ever since. It was a fantastic thing for us."



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# Ten tactics key to success with early-sown canola

**S**OWING canola early in most southern and eastern Australian cropping regions can increase productivity and profitability by following 10 key tactical guidelines.

The guidelines – relating to location, variety selection, soil moisture management, seed placement and rates, weed, pest and disease management, soil nutrition and croptop/windrow timing – have been established after an extensive three-year investigation as part of a GRDC collaborative research investment.

Through the Optimised Canola Profitability project – a collaboration between the GRDC, CSIRO, New South Wales Department of Primary Industries and the South Australian Research and Development Institute (a division of Primary Industries and Regions SA) – 34 field experiments were conducted from 2014 to 2016, looking at the interaction between variety and sowing date.

The experiments were located at 14 sites, from Eyre Peninsula in South Australia and the Wimmera in Victoria through to the central-west slopes of NSW and the Darling Downs in south-eastern Queensland.

One of the project leaders, CSIRO research scientist Dr John Kirkegaard, says the traditional canola sowing window in much of the southern and eastern growing regions has opened in late April, continuing well into late May.

## Trend to earlier sowing

“But changing rainfall patterns, disciplined summer fallow management and improved no-till seeding systems are enabling growers to capitalise on soil moisture opportunities and reduce production risk by sowing canola earlier in the season,” John said.

“The project was established to quantify potential yield and grain quality benefits from sowing crops in early to mid-April and has focused on tactical agronomic requirements to achieve successful outcomes. We have been looking at varieties that are suitable for earlier sowing and how they should be managed.”

The guidelines for early-sown canola, developed with Rohan Brill (NSW DPI) and Andrew Ware (SARDI), have been published in a new electronic *Ten Tips to Early-Sown Canola* brochure, available at <https://grdc.com.au/10TipsEarlySownCanola>.

## The 10 guidelines

- **Consider your location** – early sowing of canola before mid-April can be successful in most environments of southern and eastern Australia. The main exceptions are SA, where low rainfall probabilities in March-April are likely to restrict early sowing to around mid-April; and northern NSW, where trials show significant yield variability with early April sowing – late April or early May is preferred.
- **Select a slower developing variety** – early sowing amplifies

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**Rohan Brill (left) from NSW DPI and CSIRO's Dr John Kirkegaard have been involved in the Optimised Canola Profitability project which has led to development of the *Ten Tips to Early-Sown Canola* publication.**  
(PHOTO: Dr Julianne Lilley, CSIRO)

phenology differences between (spring) canola varieties. Sow slower-developing varieties early to target the Optimal Start of Flowering period, that is, the period when combined frost/heat/water stress is minimised and yield potential maximised. Sowing faster-developing varieties early will expose them to greater frost and disease risk at flowering and can reduce yield potential.

- **Manage fallows and residues** – management of soil moisture in the fallow period is critical for successful canola establishment. Control fallow weeds when they are small and before they start to use soil moisture. Consider potential residues, particularly from Group B herbicides and Group I herbicides in the previous crop and fallow. Spread residue evenly at harvest and retain until sowing to reduce moisture loss. Consider sowing canola after pulses, brown manure or long fallow to increase residual moisture in lower rainfall areas.
- **Manage seed placement** – consider placing seed slightly deeper (25–40 mm) for early sowing to account for higher evaporation rates. Reduce to 15–20 mm when dry sowing. If sowing retained open-pollinated (OP) seed, grade to at least 2 mm diameter to maximise establishment. Ensure the furrow is closed above the seed but avoid heavy press wheel pressure.
- **Adjust seeding rates** – establishment rates are usually lower when early sowing, with typically warmer temperatures and marginal moisture. As a guide, assume 40–50 per cent establishment for early sowing compared with 60–70 per cent for later sowing – use the higher end of the range for hybrid and large seeded OP seed. Increase seeding rates accordingly.
- **Carefully manage weeds** – early sowing usually occurs before annual weeds can germinate on the main autumn break. Select paddocks with a low weed burden and use a robust pre-emergent herbicide strategy. Select the herbicide tolerance package best suited to the weed spectrum and herbicide resistance status of the paddock.
- **Select fertile paddocks** – select paddocks high in nitrogen (N) to fully capture the higher yield potential of early sown

crops. Aim for 80 kg per hectare N per tonne of targeted grain yield. The rate of N is more important than the timing, although early sowing allows more opportunities for topdressing applications. In higher risk, low rainfall areas, sowing canola early with adequate N at seeding or early topdressing is a successful strategy.

- **Consider pests and insects** – aphid pressure can increase with early sowing but risks are reduced by controlling host weeds in the fallow period. Early sowing decreases the risk of red legged earth mite. Other pests, including slugs, earwigs and slaters, are more influenced by rotation and residue management than sowing time, although stubble retention is a successful strategy for early sowing.
- **Consider disease pressure** – early sowing can reduce the risk of blackleg crown canker in canola as young plants often develop several leaves before the onset of spore showers in autumn. Slow developing varieties sown early will flower at similar times to fast varieties sown later. Pressure from upper canopy blackleg and sclerotinia stem rot will therefore be similar and the same management practices apply. Note: If faster maturing varieties are sown too early in disease-prone areas there is increased risk of upper canopy infection, with significant impacts on yield.
- **Assess croptop/windrow timing** – early sown crops will generally branch more, particularly at lower plant densities, so a higher proportion of grain yield will be derived from branches than the main stem. Seed on branches matures slower than on the main stem. When assessing croptop or windrow timing, check seed colour change across the whole plant, not just the main stem.

The *Ten Tips to Early-Sown Canola* brochure also details Optimal Start of Flowering dates for Victoria, South Australia, central and southern NSW, and northern NSW and southern Queensland, and includes a table of proposed 'phenology' ratings of canola varieties compared with commercial 'maturity' ratings.



# As the harvest dust settles...

■ By Luke Mason, Senior Wheat Trader, COFCO International

**W**ITH the 2017–18 national winter harvest all but done, the market is now looking to confirm the size of the Aussie crop and to determine trade flows for the exportable surplus. Looking across Australia, receival data from some of the larger bulk handlers indicates to us that previous concerns of a sub-20 million tonne wheat crop are now allayed.

In Western Australia, South Australia and Victoria, improved final production numbers versus forecasts have been more notable where late rainfall and finishing conditions have offset the production shortfalls seen in New South Wales and Queensland. While official numbers will take a while to be confirmed, evidence is emerging that national wheat production is closer to the 22 mt mark. WA has come home with a late finish indicating production numbers pushing 8 mt. SA has held close to its 4 mt forecast, while next door, Victoria looks to eclipse 4 mt.

The major focus for the balance of the season now switches to demand and where Australian wheat is likely to find homes. With an export task of around 16 mt, demand will tend to switch back to more familiar ground compared to last season when the export task was some 7 mt higher.

Export demand is likely to slip from those destinations where ASW type wheat imports in 2017 had increased – namely The Philippines, Indonesia, India and China.

With Black Sea and Argentine wheat currently (early January) around \$25 to \$30 cheaper than Australian ASW and APW destination markets, this will lead to the slowdown in demand for Australian wheat.

The Philippines will still import some ASW wheat for feed purposes. This is due to a 7 per cent import advantage for Australian wheat versus other origins and quality preferences. Indonesia meanwhile is also importing more Black Sea 11.5 per cent protein wheat due to the price spread with Australia. But demand is likely to be slightly lower than last year as the Indonesian government tries to curb the surge in wheat imports used for feed markets. Nevertheless, the Indonesian industry will still need to use Australian milling wheat in the grists so there cannot be a 1:1 replacement with Black Sea.

Indian demand will also be down due to a bigger local crop. Import duty increases by India will play their part as well.

In the first four months of the export season (Oct-Jan), Australia will export around 3.8 mt. So, while this is a little bit behind schedule, the normal peak shipment months of February through to May are still ahead of us and this should put the program back on track.

At this point in the pricing season, it is hard to see a significant uptick in demand for Australian wheat. ■

## STRONG DEMAND FOR AUSTRALIAN BARLEY

■ By Ben Langford, Barley Trader, COFCO International

The past three years have seen a sustained pace in barley exports from Australia. International demand, particularly from China, is still strong whilst the wheat market has struggled to be competitive. This has seen many traders turning their attention to barley to fill nearby shipping stem commitments between now and mid-March.

Is this Chinese barley business intrinsic demand or can it be replaced by other origins? The short answer is yes but there is a lot more to our national barley crop quality and varieties than meets the eye.

These days we see three distinct Chinese barley markets which are being supplied from Australia and all three markets are at different specifications and price points.

The well-known FAQ market for malting barley has for many years been seen as a reliable supply source for mainstream, low price point, brewing demand. Protein and high test weights are critical to our barley making the grade year on year. This puts the pressure back on the shippers to select stocks to export from a varied quality profile in each port zone, to ensure contract specifications are met.

With the Malt 1 barley market, this year is shaping up to be a little more challenging given a large amount of Canadian Malt 1 being bought by China in the past five months.

It is the first time for many years that we have seen landed China pricing of this Canadian Malt 1 barley below the Australian crop – and given just how popular the Canuk varieties

(Harrington and Metcalfe) are for premium beer production, it's no great surprise.

The quality/price of new crop northern hemisphere (mainly French) barley production will be key to our malting premiums in mid 2018 when the northern hemisphere crops hit the market.

Domestically, even in the poorest quality and production years, we see demand being met by interstate and inter-port zone shipping and logistics. This puts a ceiling in the market behind malting plants where supply is not great.

Taking the above into account it helps to explain why we have seen a rally in feed barley prices when malting prices have remained steady thereby narrowing the malt–feed spread.

### Keen demand for feed barley

Why is our feed barley currently very popular even at premiums to Black Sea feed and other origins?

It needs to be remembered that all barley varieties grown in Australia are 2-row spring. This is unique in that all other export origins mainly grow 6-row winter and some 2-row spring varieties.

Our 2-row Aussie is preferred over 6 row because of its high fibre, reasonable protein, low screenings – and importantly – an average moisture content around 4 per cent lower than northern hemisphere supplies.

These factors keep buyers coming back for Australian feed barley. And given where the lower Saudi values are currently trading, it is a fantastic opportunity for Australian farmers to sell at good prices.

# Shifts in global agricultural trade – a 20-year perspective

■ By US Wheat Associates

**A** NEW study indicates that developing countries have been competing quite effectively in global agricultural trade. In addition, the study showed that agricultural products are often classified as 'sensitive products' in trade agreements, leading to a significant level of protection, especially by developing and advanced developing countries.

The report is *The Global Landscape of Agricultural Trade, 1995–2014*, released in late 2017 by USDA's Economic Research Service. The authors' summary says the Uruguay Round Agreement on Agriculture (URAA) of 1994 imposed new disciplines on market access barriers, domestic support and export subsidies, and set up rules for non-tariff measures.

In the two decades since the URAA, government interventions in agricultural trade have evolved, agricultural trade has expanded and BRIC countries (Brazil, Russia, India, Indonesia, and China) and other emerging economies have become significant agricultural traders.

The summary adds that although clear progress has been made in such areas as tariff reductions and elimination of export subsidies, there is room for further disciplines on tariffs, nontariff measures and domestic policy.

## Size of global ag export market has doubled

Specifically, the study showed that the value of global agricultural exports adjusted for inflation has doubled since 1994, indicating a significant increase in the total market size (Figure 1).

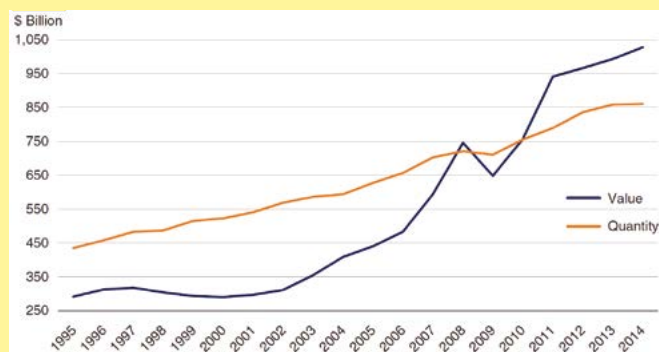
Overall, as the BRIC country share of total imports is increasing, North American and Western European countries are importing a smaller percentage of the total.

Conversely, the total share of world agricultural exports from developed countries is down from 63 to 54 per cent, while the developing country share is up from 37 to 46 per cent (Figure 2).

Global wheat trade has displayed a similar pattern.

**FIGURE 1: Quantity and value of global agricultural trade, 1995–2014**

Imports, value in US dollars, quantity in deflated US dollars, 2010 base



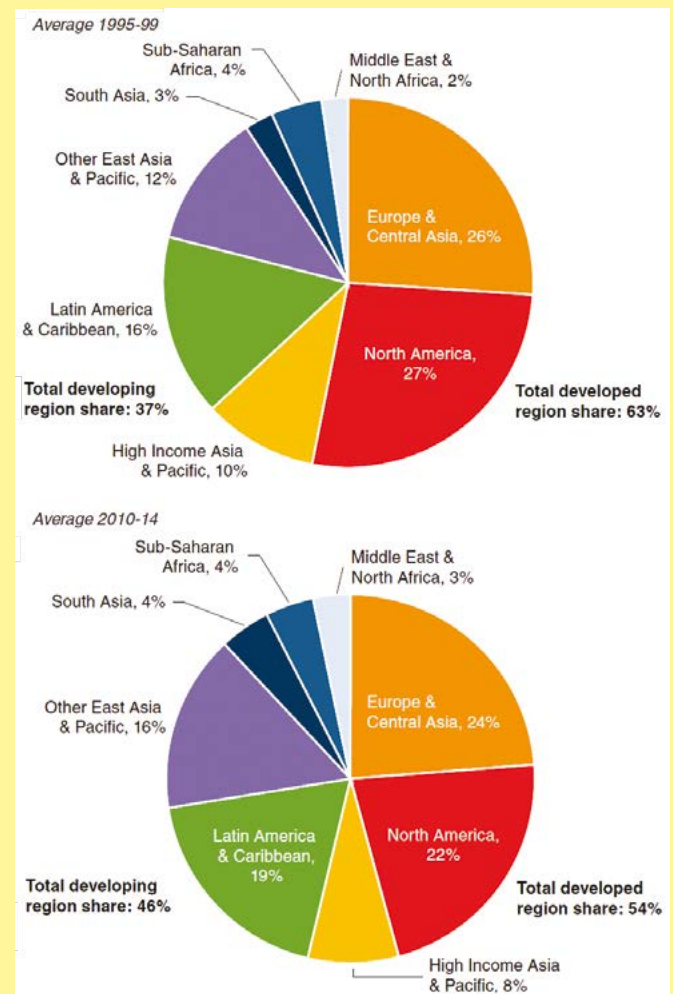
Note: Quantity is value deflated using the Food and Agriculture Organization (2017) agricultural import unit-price indices.

Source: Authors' calculations using data from United Nations, 2016.

The report summary adds that major emerging economies have increased the support they provide to farmers, sometimes using methods like price supports or input subsidies that are more likely to distort trade. In some of these countries, the study showed, recent emphasis on agriculture support is a sharp departure from earlier policies that implicitly taxed agriculture.



**FIGURE 2: Average share of global agricultural export value, 1995–99 and 2010–14**



Note: Shares are based on the nominal value of agricultural trade.

Source: USDA, Economic Research Service. Authors' calculations using data from United Nations, 2016.



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# Australian canola into the EU

**A**USTRALIAN canola farmers have reason to celebrate, with news their crop will be eligible to enter the valuable EU market as an environmentally-friendly biodiesel feedstock.

Following the submission of a CSIRO report funded by the Australian Oilseed Federation (AOF) members and the Australian Export Grains Innovation Centre (AEGIC), the European Commission has confirmed Australian canola meets strict new feedstock requirements for EU biodiesel.

To meet its own greenhouse gas (GHG) reduction targets, Europe would have shut its doors to Australian canola from 1 January 2018 unless Australian farmers demonstrated that they grow low-emission canola.

AOF Executive Director Nick Goddard said growers will feel relief over the decision, with the EU being Australian canola's largest export market, and the majority of it finding use in biodiesel production.

"The EU market is too valuable to lose for Australian canola growers. In 2016–17, Australian canola exports to the EU were typically worth over \$1.0 billion, with nearly all those exports being used for biodiesel production," Nick said.

AEGIC Chief Economist Professor Ross Kingwell said the decision will have positive impacts for the Australian canola industry, as Australia is a major supplier of imported canola for EU biodiesel production.

"Many Australian farmers rely on canola production, and securing access to lucrative markets like the EU is crucial to underpin the security and general profitability of cropping in many farm regions across Australia," Ross said.

The vast majority of Australian canola is non-GM, which attracts a price premium of approximately \$20–\$40 per tonne in the EU. This earned the Australian industry around an additional \$100 million in 2016–17. Australia's non-GM canola offers more options for the European supply chain, as residues can be used for animal feed and surplus for human consumption.

## Tracking GHG emissions

CSIRO researcher Dr Sandra Eady led the life cycle assessment report in partnership with Tim Grant from Lifecycles. They tracked the GHG emissions of all facets of canola farming in each Australian state where the oilseed crop grows.

"Australian industries are increasingly finding they need to track their emissions to meet international requirements, as well as to demonstrate their social license as good corporate citizens," Sandra said. "We used a team of experts and a range of reviewers to ensure we accurately described emissions from canola production, and are able to assist other Australian industries as they increasingly face similar requirements."

The report found that the greatest emissions came from the manufacture of fertiliser, the breakdown of crop residues, and emissions from soil. Emission variation between the Australian states was largely driven by climate differences.

Until the end of 2017 the EU's Renewable Energy Directive requires feedstocks to deliver GHG savings of at least 35 per cent compared to fossil fuels. In January 2018, this target increases to 50 per cent for biofuel refineries built before October 5, 2015, and 60 per cent for installations commissioned since 2015.

Any country selling feedstock for use in EU biodiesel must demonstrate it meets these higher levels of emission savings to

comply with EU targets. With an average carbon footprint at the farm gate of 468 kg of CO<sub>2</sub> per tonne of seed, Australian canola will be very competitive in this important market. Australia was one of the first non-EU member states to submit a *Country Report* to the European Commission outlining its emission profile of canola.

The industry collaboration between AEGIC, AOF and CSIRO was crucial to the successful outcome announced by the European Commission. The Australian Government also played an important role in facilitating the review of the *Country Report* by the European Commission. ■

## THE EUROPEAN UNION'S UNEASY RELATIONSHIP WITH SCIENCE

■ By Elizabeth Westendorf, US Wheat Associates

Late last year, the European Court of Justice ruled that EU member states cannot ban cultivation of genetically engineered crops without scientific evidence of risk to human health.

The ruling was on a case that dates back to 2013, when an Italian farmer wanted to plant biotech corn. Italy has long banned the planting of genetically engineered crops. The farmer in question, Giorgio Fidenato, planted the corn on his land in defiance of Italy's ban. Four years later, it is a win for science-based regulation that the European Court of Justice sided with Fidenato and ruled that Italy does not have the right to ban GM crops without a scientific reason.

It is not all good news for science in Europe though. The EU has previously had pesticide legislation that sets risk-based tolerances and maximum residue levels (MRLs). But the EU is now in the process of introducing hazard-based restrictions on import tolerances. These restrictions are not only contrary to the EU's MRL legislation but also contrary to the World Trade Organization (WTO) Sanitary and Phytosanitary (SPS) Agreement, which requires that decisions be based on risk assessments.

A hazard-based approach risks significantly impacting trade and affecting product availability in the EU. This would also jeopardise trade litigation that could result in retaliation against billions of dollars of its exports.

For a highly traded commodity like wheat, it is imperative that regulatory systems worldwide be transparent and science-based. Otherwise, exporters may have shipments held up – or prevented altogether – and importers cannot rely on deliveries arriving in a timely manner.

When technology does not have a negative impact on health or the environment, there is no reason for countries to needlessly restrict its use, or worse, vilify its existence.

It is heartening that the EU has taken a step in the right direction on biotechnology, but they are moving backward on SPS issues that could inhibit trade and hurt domestic businesses. Unscientific regulations make it hard for a globalised market to function well.



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# Blockchain – could it revolutionise the food and agri supply chain?

**T**HERE'S a lot of excitement and talk about 'blockchain' but yet little is known about what it actually is, and how this digitised technology could be implemented in the agriculture sector.

Wes Lefroy, Rabobank's agricultural analyst has been closely following the potential of this new digitised approach to managing supply chains, and how it could revolutionise the food and agri supply chain, as we know it.

Authoring an article, *Blockchain: Changing Interaction in the F&A Supply Chain from Paddock to Plate*, Wes looks at the shift towards a digitised supply chain and why it holds great promise for farmers through to the consumer.

"Conceptually, blockchain makes a lot of sense but the potential of it in the agri sector is not something that has been widely considered," Wes says. "Yet the shift towards this technology is progressing quickly and it might be here quicker than we think, with a number of companies already trialling the technology."

## Blockwhat?

As a digital platform, Wes says 'blockchain' facilitates the transfer of physical commodities right along the supply chain, whereby all transactions are recorded on a shared ledger.

"This shared ledger, essentially a record book, records all the financial transactions, as well as any data or information, that is associated with transferring the physical commodity along the supply chain – from farmer to consumer," he says.

All those involved in the transaction would have their own copy of the ledger, and each time a transaction is made, a new record (or block) is created and added to the blockchain.

"For it to work, input suppliers, farmers, port authorities, banks, logistical providers, and processors, all need to participate in a common interface and enter their digital information in the same blockchain," he says.

## What does it mean for farmers?

Blockchain offers huge possibilities, given consumers are



**Wes Lefroy, Rabobank's agricultural analyst.**

increasingly demanding high-quality and safe products – as well as, visibility of the supply chain.

The two major benefits blockchain delivers are transparency and provenance, but the secure nature of blockchain also removes counterparty risk – or the "will I get paid?" element from the transaction.

"With blockchain facilitating traceability, it is set to drastically simplify the process of verifying product origin, quality attributes, and production practices," Wes says.

"For example, farmers will have much greater understanding of changing consumer preferences, giving them direct feedback into the demand for the different products they are producing.

"And in turn, consumers will have greater verification of how the product was grown, with input data and production location verifiable."

For blockchain to 'take off', it requires involvement from all the stakeholders along the supply chain.

"This is particularly pertinent for farmers, as the provenance story is diluted, without high-quality information about production inputs and origin," says Wes.

## Commercialisation yet to take off

At home and abroad, the shift towards a digitised supply chain is progressing quickly.

"In Australia, the world's first settlement of a transaction involving a physical commodity on the blockchain was completed in 2016 by Australian agtech company, AgriDigital," says Wes. "And since then, we have seen some major grain handlers testing the application of this technology, with blockchain pilots also taking place for other commodities such as pork and mangoes."

While there are still barriers to wide-scale adoption, such as calculating a proper distribution of costs and benefits, Wes says "there is no doubt that it holds promise and is the way of the future".



**A 'blockchain' digital platform facilitates the transfer of physical commodities right along the supply chain, whereby all transactions are recorded on a shared ledger.**



# Wheat a kick in the guts for fighting diseases

■ By CSIRO

**A** NEW type of wheat that has 10 times the amount of the fibre which helps improve gut health and also fight bowel cancer and Type 2 diabetes than normal wheat, has been developed by an international team including CSIRO.

The new wheat could provide millions of people with a lot more fibre without having to change their eating habits.

In the American states of Idaho, Oregon and Washington, a small number of farmers have just harvested the first US crop of the wheat, which is high in amylose.

The wheat will be processed into flour and incorporated into a range of food products that Americans can expect to see appearing on their supermarket shelves in coming years.

Dr Ahmed Regina, a principal research scientist at CSIRO, said products made from high-amylose wheat contained more than 10 times the resistant starch, a type of dietary fibre, than those made from regular wheat.

"Largely lacking in Western diets, resistant starch is known to improve digestive health, protect against the genetic damage that precedes bowel cancer and help combat Type 2 diabetes," Ahmed said.

"Wheat is the most popular source of dietary fibre and eaten by 30 per cent of the world's population, whether it's in bread, pizzas, pastas or tortillas.

"Having a wheat with high levels of resistant starch enables people to get this important fibre without changing the type of grain they eat or the amount of grain-based foods they need for recommended dietary levels."

The team responsible for developing the new type of wheat are hopeful an Australian-based company will capitalise on the opportunity to market it locally.

The wheat is a result of a collaboration which started in 2006 between CSIRO, and French company Limagrain Céréales Ingrédients, and the Grains Research and Development Corporation on developing wheat varieties with a higher content of resistant starch.

Together they spun out a company called Arista Cereal Technologies.

## The breakthrough

A breakthrough came when they identified two particular enzymes, that when reduced in wheat, increased the amylose content.

"From there, we used a conventional breeding approach, not GM techniques, and managed to increase the amylose content of wheat grain from around 20 or 30 per cent to an unprecedented 85 per cent," Ahmed said.

"This was sufficient to increase the level of resistant starch to more than 20 per cent of total starch in the grain compared to less than one per cent in regular wheat."

US-based, Bay State Milling Company was the first company to take this technology to the market through a licensing arrangement with Arista.

This year they contracted farmers to grow about 400 hectares of the wheat, which will be marketed as HealthSense high fibre wheat flour.



**Dr Ahmed Regina with some of the new high-amylose wheat. (PHOTO: CSIRO)**

"We are very excited to launch HealthSense in the US and change the way Americans think about wheat," Bay State Milling CEO Peter Levangie said.

"HealthSense will deliver flour functionality to our customers and fibre benefits to consumers, enabling better human health through the foods they love to eat."

In Australia, Arista is partnering with a breeding company to develop high-amylose wheat varieties suitable for different regions. They are working on producing enough grain for product testing and seeds for initial commercialisation.

Lindsay Adler from CSIRO and an Arista director, said the company was keen to find an Australian licensee who would develop a new product for local and possibly also Asian markets.

"This is an opportunity ripe for the picking, with customers across the world increasingly demanding foods with improved health benefits," Lindsay said.

CSIRO has developed other novel grains that commercial partners have taken to market, including the ultra-low gluten barley, Kebari and BARLEYmax, a barley with high levels of resistant starch.

**Acknowledgements:** CSIRO, Limagrain Céréales Ingrédients, Grains Research and Development Corporation, Arista Cereal Technologies.

## More information

**A genetic strategy generating wheat with very high amylose content. High amylose wheat generated by RNA interference improves indices of large-bowel health in rats.**

# Cultivation of industrial hemp for fibre, food and bioactives

■ By Jan Slaski, InnoTech Alberta, Canada

*Jan Slaski and his industry colleagues have published a comprehensive online eguide to hemp production in Canada – please see <http://www.hemptrade.ca/eguide/production/variety-selection>. Following are excerpts from the guide compiled by Stuart Gordon (CSIRO) with permission from Jan Slaski.*

INDUSTRIAL hemp in Canada is grown primarily for grain, although fibre and hurd (pressed inner woody core used in the construction industry) products are also important. Noting that Canadian climate and soils are quite different from Australian conditions, the following information should be treated as a guide only. But the broadacre production systems of Canada are similar in scale and output to the systems in Australia.

Jan and his colleagues note that industrial hemp is typically grown under any traditional Canadian conventional production system. It fits in well with typical crop rotation systems and uses equipment that would already be found in a grain production system.

Hemp has been successfully zero-tilled in many situations as long as the seedbed is warm, firm and moist to encourage fast, uniform emergence.

The hemp plant's rapid growth, once established, makes it an excellent crop to be grown successfully under organic production systems. Pre-seed cultivation is often done early to stimulate weed growth and warm up the soils by incorporating residue.

Good fertility in terms of nitrogen and warm, moist seeding conditions and shallow sowing (1.5 cm) are required to ensure the crop has a good start to compete with weeds.

## Hemp varieties

There are currently eight companies in Canada involved in hemp plant breeding:

■ Parkland Industrial Hemp Growers;



Parkland Crop Diversification Foundation variety trials headquartered in Roblin, Manitoba.

Dr Jan Slaski will be speaking at the Australian Industrial Hemp Conference being held in Geelong, February–March 2018.

Jan is a Senior Researcher and leader of the Crop Development and Management team with the Ecosystems and Plant Sciences Unit of InnoTech Alberta, Vegreville, Alberta.

During the past 16 years he has led research on the introduction and breeding of hemp varieties that suit the needs of the fibre and food industries on the Canadian Prairies.

Jan has also conducted extensive studies on best management practices that permit sustainable hemp production under changing environmental conditions. To fully realise the potential for industrial hemp, and to assure whole crop utilisation, Jan has assembled a research program at InnoTech Alberta that offers solutions from “seed to final product”. The program includes three domains:

- Breeding and agronomy;
- Fibre processing; and,
- Product development.

Since 2012, Jan has served the industrial hemp industry as a director of the Canadian Hemp Trade Alliance.



- PhytoGene Resources Inc.;
- Hemp Genetics International Inc.;
- Hemp Oil Canada Inc.;
- Alberta Innovates – Technology Futures;
- Terramax;
- Uniseeds; and,
- Stonehedge Phytomedicinals Inc.

Varieties are tested in separate but coordinated variety performance comparison trials in various locations across Canada. The objective of the trials is to compare and evaluate varieties under diverse climate, soil types and growing conditions in regions where hemp is being grown.

Provincial seed guides are published each year and provide a summary of the varieties tested so producers can select the best suited variety for their area of production. Trials are controlled for seed source, soil type and variability, fertility, weed control and management.

## Seeding dates and rates

Seeding date can have multiple impacts on hemp yields. The pros and cons of a particular date are dependent on the producer's situation in terms of weather, field preparation and water inputs. The following observations have been documented for Western Canada:

- The yield advantage to earlier seeding is not conclusive. There are many factors such as soil temperature and moisture that





Typical seeding equipment for zero tillage of hemp.



Hemp's tap root makes it a good moisture forager at depth.

can have an impact on yield. Earlier sown crops can be more vulnerable to these factors. Further research is required in this area.

- Mid-seeding dates (mid-spring) are more ideal for hemp production. There is less plant mortality due to warmer soils giving rise to faster emergence. Uniform stands result in better weed competition, more uniform seed maturation and improved ease of harvest. Plant height from a mid-seeding date is somewhat shorter than with early seeding dates.
- Harvest date is not typically significantly impacted by seeding dates due to the hemp plant's photoperiod sensitivity effect.

- Later seeding dates (mid-summer) are not recommended and producers should only consider this option as a last resort when there are no other cropping options available. It may be a viable option over a summer fallow if weather conditions allow prolonged seeding intentions. Observations have shown reduced yields and plant height at later dates.

The end use of your hemp crop will dictate the seeding rate. Grain crops are sown more sparingly than fibre crops. A target seeding rate for grain production is suggested to be between 100 to 125 seeds per m<sup>2</sup>. Weed suppression before sowing is particularly important for grain crops because the plant density will not be able to out-compete the weeds.

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The seeding rate for fibre crops should be double that used for grain production (200 to 300 seeds per m<sup>2</sup>). The reason for higher seeding rates is to ensure a higher quality fibre crop. Good quality hemp fibre comes from plants that are straight and 'pencil thin'. Higher seeding rates ensure that there will be a high plant population of tall thin plants with longer internodes.

Research is limited in Canada (and elsewhere) on the appropriate seeding rates to achieve high yielding, good quality fibre and for dual cropping (grain and fibre).

## Soils

Industrial hemp will grow on a wide variety of soil types and conditions. Hemp tends to do best on soils with good fertility and drainage. Hemp can do very well on sandy light soils due to its large tap root that can source moisture and nutrients from deeper in the soil profile.

Heavier clay soils present the biggest challenge to growing hemp. In the early stages of hemp growth, young plants are not able to withstand cool, waterlogged soils. Soil compaction, which is more prevalent on heavy clay soils, is also a cause of increased seedling mortality. Hemp plants in clay soils with poor drainage that remain wet and 'pond' water for long periods of time will not do well.

Stress in these early stages of plant development can delay crop growth, which can result in weed control problems later in the year and potential yield reductions.

After heavy rains and cool conditions the hemp plant can become chlorotic at its centre growing point. If the growing point, which is in the middle at the top of the plant, becomes severely damaged in the early growth stages, the plant will likely die. Sunny hot conditions after a heavy rain usually means the plants will recover.

## Nutrients

Hemp, whilst a resilient plant, requires reasonable availability of nutrients to achieve good yields – see Table 1. Hemp uses a total of 200 kg per hectare of nitrogen; 40 kg is removed in the seed and 160 kg in the stalk. If the hemp is grown for both grain and fibre production, there will be a large amount of nitrogen removed from the field and growers need to be cognizant of nitrogen requirements for the next production year.

The breaking down process of the straw allows nutrients like nitrogen and potassium to be leached out and accumulate in the soil under the cut swaths. Of all the nutrients, phosphorus has the highest percentage stored in the seed. The other nutrients are more inclined to be stored in the stalks.

Depending on the variety, hemp will grow seven to 10 cm a day during its vegetative stage in July to early August. During this development stage, the maximum rate of nitrogen uptake is about 6.7 kg N per hectare per day. Phosphorus uptake is about 1.6 kg per hectare per day.

Hemp seed, as with other crops, will be sensitive to seed-placed nitrogen fertiliser. It is recommended that nitrogen be broadcast, side-banded, mid-row-banded or banded in a separate operation.

Hemp is a high user of phosphate and it is essential to have phosphate in an available form early in crop establishment and during the growing season. Phosphate is immobile in the soil so close association to hemp roots is essential. Phosphate management trials in the past have shown that hemp does have some tolerance to seed placed P. Soil type, soil moisture and seed opener spread all have an effect on seed placed phosphate, so caution should be used to find a rate that is suitable with your conditions and equipment.

Micronutrient deficiencies in hemp are less common than macronutrient deficiencies and part of this may be due to the lack of documentation and reporting. More research and documentation of micronutrient identification, deficiencies and yield effects is required.

**TABLE 1: Nutrient uptake and removal by field crops (kg per hectare)**

Nutrient	Total plant (kg per hectare)		Grain (kg per hectare)		Uptake Hemp/ day**
	Hemp*	Canola**	Hemp*	Canola*	
N	200	120	40	65	6.7
P	47	50	19	35	1.6
K	211	75	10	17	6.0
S	14	20	3	12	

\*Source Canola: Canadian Fertiliser Institute. \*\*Source Hemp: MAFRD.

## Weed control

In Canada, limited herbicides are registered for use for weed control in hemp. Seeding into warm, moist and fertile soil is currently the best recommended weed control option for hemp production. When planted under ideal conditions, hemp will germinate very quickly and reach 25 to 30 cm in height two to four weeks after planting. At this stage, hemp enters the vegetative and elongation stage. It is also at this stage, where

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hemp provides about 90 per cent of the ground cover which enables it to suppress the growth of weeds.

Assure II, a product of Dupont Canada, is now registered (2015) for industrial hemp grown for fibre, seed and oil production. Use of Assure II allows for control of grassy weeds. No herbicides are presently registered in Canada for broadleaf weed control.

Crop rotation is also important to avoid unwanted weed problems from volunteer crops. Grassy crops such as wheat, barley, oats and weeds such as wild buckwheat are difficult to remove during grain cleaning.

Hemp is sensitive to most herbicides residues. It is important to be aware of previous herbicides used on a field that is designated for hemp production. Herbicides used for spring burn off of volunteer glyphosate tolerant crops may have a soil residue that would be harmful to hemp.

Sanitation is also an important consideration to keep out contaminants such as weeds and volunteer crop from a hemp crop at harvest. Clean handling equipment, such as bins, trucks, augers and any piece of equipment coming in contact with the grain.

### Irrigation

Hemp responds well to soil moisture availability during the growing season. Limited research (from Europe) shows hemp requires around 500–700 ml of precipitation per growing season, which in Europe is met entirely by rainfall.

Research has shown that on average 300–500 litres of water are required for the production of 1 kg of dry matter. Recent trials in southern Australia in clay and sand reported water consumption of between 120 (clay) to 220 ml (sand), by irrigation and rainfall, in the first six weeks from post-emergence.

Hemp yields will be highest when there is adequate soil moisture throughout the growing season. Adequate soil moisture is defined as maintaining 50 per cent or more of the available soil moisture in the root zone.

### Pests and pathogens

A number of insects including grasshoppers, army worm, stink bugs and Lygus plant bugs, have been found feeding in hemp. To date none have been found at economic levels that would require control. But as acreages increase and production becomes more intensive it is expected common pests of other crops may become a problem.

No insecticides are registered for use on hemp field crops. Birds can also be pests in a hemp crop, particularly close to grain harvest when the flower head and seed casings are exposed.

No fungicides have been registered in Canada for use on industrial hemp for any disease. Further research is required to determine the efficacy of the products and timing of application. Crop rotation is the best cultural practice to avoid disease build-up. *Sclerotinia sclerotiorum* (white mould) and *Botrytis cinerea* (grey mould) are the most serious diseases affecting industrial hemp.

### Harvest dates and equipment

Hemp matures in 90–120 days, depending on variety, seeding date and summer temperatures.

Industrial hemp seed is harvested when the seed begins to shatter.

Standing hemp is harvested when approximately 70 to 80 per cent of the seeds are ripe and the grain sample has a seed moisture range of 10 to 20 per cent. Hemp is indeterminate in growth so the seeds at the top of the head will be less mature than ones on the bottom.



Hemp head ready for harvest.

Hemp is ready for combine harvest when the bracts around the seed have dried up and the seed is exposed (see photo above).

Harvest method and equipment should be an early consideration when deciding to grow a hemp crop. When hemp is combined, the more immature seeds from the top of the head will retain some of the bracts that surround them. The bracts and the broken plant material in the combine hopper mean the sample is high in moisture.

In a dryer, the plant material does dry down fairly quickly.

Later combining can result in increased grain losses due to shattering, bird damage and lower quality grain. Mature fibres tend to wrap more tenaciously around moving parts on the combine as the crop dries down.

Hemp grain harvesting is generally done by straight combining, but swathing is used in a few areas in Western Canada.

The newer models of combines are best suited to handling the hemp harvest and require minimal modifications. The new machines have bigger cylinders and cleaning area. Combs can be operated at higher levels so all stands of hemp can be accommodated.

Most new combines are now rotary design. Some new machines have the swath entering at the bottom of the cylinder. On earlier machines, the swath would hit the middle of the rotor after leaving the feeder housing. The rotor then had to direct the material up the side of the rotor. This slight hesitation would be enough to allow the hemp to wrap on the front bearing of the rotor.

The product flow is smoother in new machines. The draper header is preferred by growers.

While getting ready for the Geelong conference I want to invite you and all Australian hemp researchers and industry stakeholders to Vancouver, BC in July for the Hemp Pacific Rim Conference <http://business.hemptrade.ca/events/details/hemp-pacific-rim-conference-42>. We just opened calls for speakers <http://business.hemptrade.ca/form/view/10943>.

# Are you going spraying or killing weeds?

**S**PRAY drift is of great concern for sensitive crops and environments, along with the fact that if the spray doesn't hit the intended target, you do your dough and your weeds live. Bill Gordon, spray application consultant with Nufarm Australia says the focus of spraying herbicide needs to be on doing the job right so the weeds receive the correct dose and die, and this includes reducing the airborne fraction to a bare minimum.

"In many cases this means not spraying at night if the wind speed is too low," he says. "Many product labels prohibit night spraying due mostly to the risk of spray drift. Our studies have shown that with a coarse spray quality drift may travel up to 300 to 400 metres during the day after any inversion has broken, but spraying at night can leave up to five times as much chemical in the air using the same products, nozzles and ground speed. This can result in spray drifting 10 to 20 km or more at night, and this is unacceptable for other farmers, the community and the environment."

Bill says most growers are implementing best spray practice when it comes to boom height and nozzle selection but the temptation to spray at higher speeds and into the night can over-ride common sense at times.

"The flip side of this is that it is becoming more evident that using Delta-T as the main determinant of safe day-time spraying conditions may not be the best approach," he says. "What really matters most is the wind speed and whether the weeds are stressed or not."

"If the weeds are not stressed on a hot day, due to ample soil moisture, then spraying at a higher Delta-T may still be effective and safe, with coarse droplets surviving quite well and not becoming airborne."

This can essentially increase the number of daytime hours available to growers to get the job done without spraying at night or early in the morning when the risk of spray drift is the highest.

"Getting onto paddocks as soon as possible after rain and using up the daytime hours to target priority paddocks will maximise weed control and minimise spray drift risk," says Bill. "Spraying can continue into the evening in summer if the soil remains warm and the wind speed stays above 12 km per hour. If the wind drops off, then spraying should cease, usually by about 10 pm through to a few hours after sunrise."

The bottom line is that it is very difficult to determine a safe night-time spraying conditions (see chart opposite).

## Extending the safe spraying window

When environmental conditions are borderline in terms of wind turbulence, the safe spray window can be extended slightly through the use of coarser sprayer quality where the proportion of droplets less than 150 microns is 10 per cent or less, keeping drift to a minimum. But the trade-off is reduced efficacy when using very coarse droplet size, particularly when the target is small, vertical or hard to wet.

"When buying new nozzles, check them against the new standard, which shows spray quality with adjuvants rather than water only," says Bill. "The GRDC has recently updated and published the 2017 Nozzle Selection Chart for growers to use as a reference. Using the correct nozzle and adjuvant combination can have a positive impact in reducing spray drift and maintaining efficacy."

"Reducing ground speed by just five km per hour can also make a big difference to spray coverage and efficacy of weed control, particularly if there is a high stubble load present," he says. "Water sensitive paper, in combination with apps such as 'SnapCard', is a good way to test the coverage, penetration and spray pattern achieved under different conditions, such as different ground speeds."

Bill's rule of thumb for effective weed control when applying fully translocated products (eg. glyphosate and Group I products) is a minimum of six to eight per cent coverage, while coverage of 10–12 per cent or more is required for contact herbicides.

"Pre-emergent herbicides are the most difficult to judge due to the number of variables involved in their effective application, but as a rule of thumb I generally look for coverage of at least 15–20 per cent," he says.

If you are going out killing weeds, you need to get everything right.

## 10 Tips for reducing spray drift:

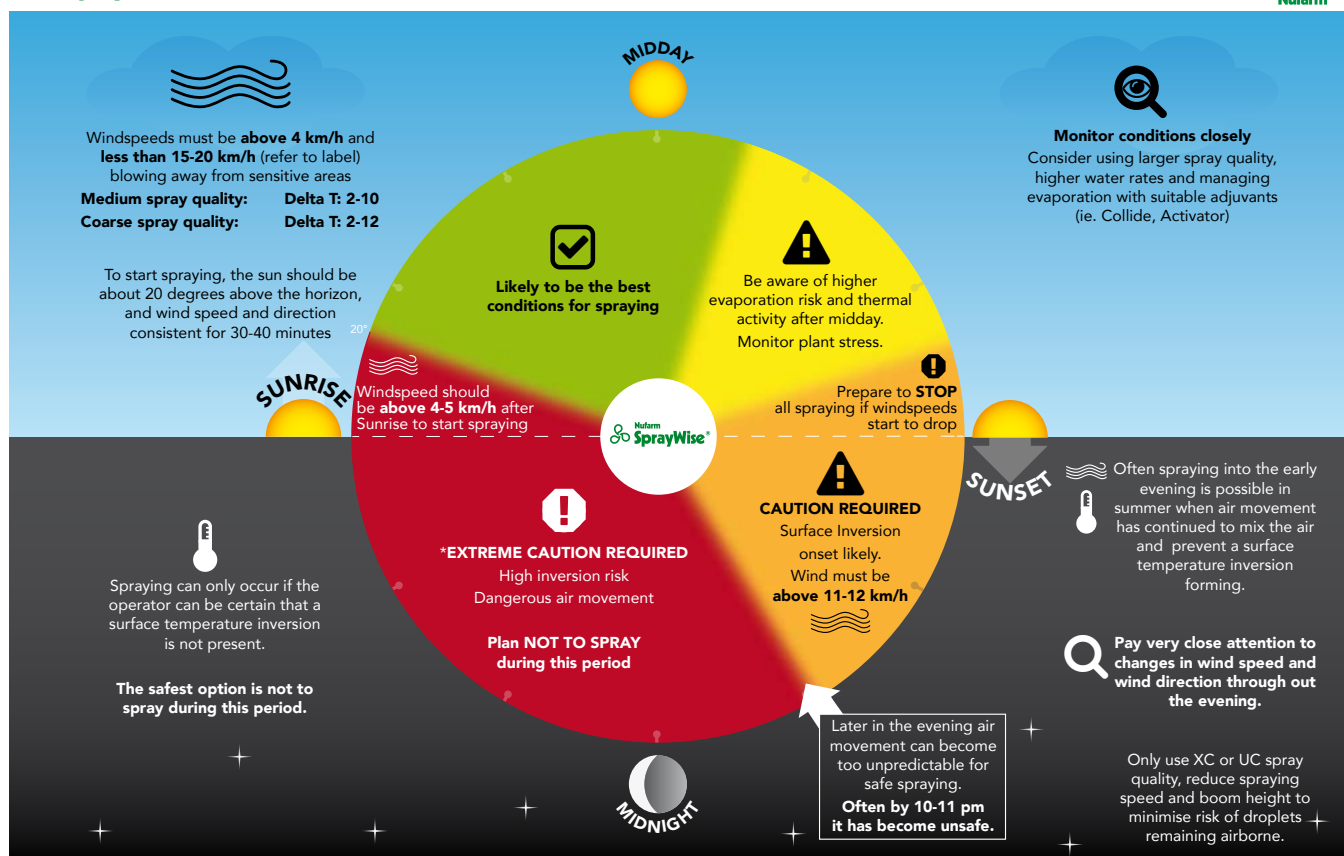
- Choose all products in the tank mix carefully.
- Understand the product mode of action and coverage requirements.
- Select (and check) the coarsest spray quality that will provide effective control.
- Expect that surface temperature inversions will form as sunset approaches and will likely persist overnight and even beyond sunrise on many occasions. DO NOT SPRAY.
- Use weather forecasts to inform your spray decisions.
- Only start spraying when the sun is about 20 degrees above the horizon and when the wind speed has been above 4–5 km per hour for more than 20–30 minutes, and clearly blowing away from any adjacent sensitive crops or areas.
- Set the boom height to achieve a double overlap of the spray patterns.
- Avoid higher spraying speeds.
- Leave buffers unsprayed if necessary and come back.
- Continue to monitor conditions, particularly wind speed, at the site during the spray operation.

For more information about managing spray drift, visit the WeedSmart website: [www.weedsmart.org.au](http://www.weedsmart.org.au)



Bill Gordon, Nufarm spray application consultant, says most growers are implementing best spray practice when it comes to boom height and nozzle selection but the temptation to spray at higher speeds and into the night can over-ride common sense at times.





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# Minimise spray drift – good farmers manage it!

■ By John Single, Narratigah, Coonamble

**T**HE recent publicity surrounding herbicide damage to cotton crops is just the tip of the iceberg. Phenoxy damage to cotton is dramatic in that it is highly visible and can be hugely detrimental to yield. Hence cotton receives the publicity, and unfortunately in the eyes of some, cotton growers are seen as the bad guys as they restrict the use of herbicides in cotton growing areas.

What rubbish! We all have a very clear obligation to contain all pesticides to their intended target, legally, morally and most importantly – environmentally.

All too frequently we are seeing herbicide damage to all types of crops and from the various chemical groups – not as obvious as cotton – but it is occurring. We see it in leaf decolouration, irregular plant growth, reduced or a loss of tillers and in worst instances, plant death. How often do we drive through cropping areas and witness the obvious damage to the trees, or drift on to pasture country.

In isolated instances traces of paraquat has been detected in grain. That is frightening. And what is that distortion in my garden plant and why did that garden plant die?

As one of a number of growers who helped develop our current zero till cropping systems in the 1980s and then proudly promoted “maximum sustainable economic yield” through zero till in the early 1990s, it is way past time to speak out about pesticide damage that is occurring in this great industry of ours.

## **We own the problem – we should fix it!**

We own the industry, we are causing the problem and we must fix it.

If we choose to do nothing, there is no doubt that in time the problem will be fixed for us. Look at what is happening on the regulation front in other countries, particularly in the European Union and North America. In some cases farmers wanting to apply a pesticide to a field need to have that field inspected by an agronomist, the agronomist approves, or not, the pesticide

application, the agronomist certifies that the farmer can purchase enough pesticide to apply to that field (and only that field), then the farmer can purchase that pesticide after demonstrating that they are qualified to apply it.

There is no debating that the current situation is unacceptable – it simply must change. The choices are simple, do nothing and watch government cover the agricultural industry with red tape, and/or have certain pesticides banned because of irresponsible use – or we self-regulate.

Self regulation could take many forms, with education being the obvious starting point. But let's make certain that the information we put out there is complete.

Drift occurs in many different situations and it all needs to be contained.

## **Inversion layer drift is the killer**

But the primary focus is inversion layer drift.

The industry has itself to blame for inadvertently promoting night and early morning spraying, when inversion conditions are most likely to exist.

This has occurred through the promotion of Delta-T conditions under which to operate – ideally of no more than a Delta-T 8 – which in the summer months principally occurs at night and early morning. This has promoted better herbicide efficacy.

Unfortunately, no-one said where to measure Delta-T. As a result we generally rely on various weather stations that record well above ground level.

But it is at ground level in the spraying environment that we should be most interested in.

Frequently Delta-T is less at lower heights, hence spraying can continue further into the day reducing the need to apply at night.

Weed stress and size have a huge effect on herbicide efficacy, and small rapidly growing weeds are far easier to control than large stressed weeds.

In a fallow spray program it is often better to extend spray hours past Delta-T of 8 in order to apply to small actively growing weeds – again reducing the need to spray at night.

There is good information about on how to contain drift – but the age old industry problem is how to beat that information into growers' heads.

Habits are hard to break, particularly when dollars are involved. Chemical card training should be ramped up to include detailed information on drift control, APVMA need to look at labelling to include very prominent inversion layer restrictions. A minimum of a 3 km per hour wind does not mean that there is not an inversion layer.

If your crops suffer drift from neighbours, let them know – they may not realise that they or their operators have caused a problem.

The industry used to have the slogan: “Conservation farming, good farmers manage it.”

It could now be: “Minimise drift, good farmers manage it.”

Let's hope that we don't instead resort to “it's cool to dob in a drifter” and need to bring in a further drum levy similar to *Drum Muster* to fund policing of our great and proud industry. ■



**John Single is calling for proactive change to counter increasing spray drift issues. Industry self-regulation is needed.**



## SPRAY CONSULTANT COMMENTS...

Mary O'Brien is a spray application consultant based in southern Qld where a wide mix of side-by-side summer and winter crops has made her an experienced authority on spray drift. Mary has been involved in countless field days, seminars and on-farm demonstration sites focussing on safe and effective use of farm pesticides.

*Australian Grain* has asked Mary to comment on John Single's whole of industry 'wake-up' call when it comes to spray drift (see opposite).



Mary O'Brien.

John is making some very good and valid points, particularly in his call for all crop production sectors to take ownership of the spray drift issue. If there is not a united and effective management approach to stop spray drift damage, pesticide products will be lost with a huge impact on our ability to manage resistance.

Spray drift minimisation should be uniting the crop production sectors, not dividing them.

We often have an unhealthy obsession with Delta-T that in practice, pushes people to spray at night. To flesh out John's comments on Delta-T a bit more, it is widely accepted that a reading of 2 to 8 is in the go range. But unfortunately, many operators don't know that this is for a 'fine' spray quality.

For fallow sprays where Group I products are used, 'coarse' spray quality is the minimum legal requirement. So when using larger droplets we can push that Delta-T out to about 12, or in some instances 14, thereby providing more opportunity for less risky daytime spraying. We refer to Group I chemicals because of their notoriety in summer crop drift issues. But we need to be equally diligent across all chemical groups throughout the year.

There is a great 'Spray Clock' recently released by Nufarm, and developed by my spray application consultant colleague Bill Gordon. The Spray Clock is a very good summation of when and when not to spray (see chart page 37).

Bill has always recommended measuring Delta-T both in the air and also at the plant target height. If there is good soil moisture and the plants have not shut down and are transpiring well, the Delta-T will be a better guide if measured at the target plant.

Delta-T should be used as a guide only – it is not the bible as many treat it.

### Chemical labels and temperature inversions

John is also suggesting beefing up the industry chemical card training as well as drum labelling, particularly with respect to spray drift – and I couldn't agree more – but we need more focus on technical issues such as temperature inversion identification.

The trainers must also be up to speed on what causes drift and importantly, what the best drift minimisation strategies are across the full range of local environmental conditions.

The trainers must then have the skills to pass this information on to operators who, in turn, are willing to take it on board.

There are instructions on the chemical label stating 'do not

apply during surface temperature inversions'. The problem is that very few operators can tell when there is an inversion.

John rightly makes the point that temperature inversions can still be in place even when there is a wind above 3 km per hour. I have seen many situations where temperature inversions are in place in spite of wind blowing well above 3 km per hour. It is very dangerous to assume a low inversion risk even if there is a 3 to 15 km per wind.

We need to also keep in mind that inversions are not just a summer spraying issue. Inversion events in winter can often persist for longer (ie. start earlier in the afternoon and won't break until later the next morning).

### Industry-wide responsibility

I often hear farmers and operators blaming the particular chemical, the chemical company, the APVMA or the consultant when spray drift occurs. The best response to this is by way of an analogy:

If I buy a V8 Commodore and I get a speeding ticket, is that Holden's fault or mine? I have bought a product that is capable of doing 5 km hour or up to 260 km per hour. How I use my bought product is my problem.

To apply the analogy, if I buy a Group I herbicide I need to know the capabilities of the chemical and how it is formulated before I can 'drive' it safely.

This season we have seen broadscale drift damage to cotton and other summer crops. While there are some products marketed as low volatile esters, they are still a lot more volatile than the amine formulations.

The issue with low volatile ester formulations is that it doesn't matter how good the conditions are when it is applied, it can volatilise and move off target up to 72 hours after the application – and with the soil temperatures we get in summer – that is a very real problem. When it vaporises into gas form, it can then move during the day or during inversions. That's why these LVE ester products are just not suitable to use in summer.

It is in the best interests of farmers and operators and the industry as a whole to act proactively and do the right thing.

The bottom line is that every single factor that impacts on drift is within the control of the operator – formulation, nozzles, timing, speed, boom height and tank mix.



This smoke test shows air movement during surface temperature inversions.

# Weed spotting by drone

■ By J. Kim Kaplan, Agricultural Research Service – USDA

**W**HEN ARS agricultural engineer Yanbo Huang hears a drone in a field, he is not hearing the droning of bees pollinating plants nor the thrum of a tractor or combine. Yanbo and his technician Ryan Poe are just out flying their DJI Phantom drones. They are flying the drones – formally known as unmanned aerial vehicles (UAV) – 30 to 60 feet above a soybean field near their lab in the ARS Crop Production Systems Research Unit in Stoneville, Mississippi, to hunt for glyphosate-resistant (GR) weeds.

Yanbo can already correctly identify a weed as GR or not GR about 90 per cent of the time from lab and field studies. Signs of glyphosate resistance have shown up in 10 different weeds across Mississippi. Several of the weeds have become major concerns to farmers, such as GR palmer amaranth (pigweed) in soybeans and GR Italian ryegrass in cotton.

“These two are perhaps the biggest problems right now,” says Yanbo. “Growers need to know which weeds in a field are glyphosate resistant and which are not, so they can apply the least expensive and least toxic herbicide and avoid spraying all of the weeds with more than one herbicide.”

Yanbo says the choices are to have someone walk through the field and collect samples from each weed, which is costly and inefficient, or gather data by remote sensing through satellite, airplane, ground-based, or drone-mounted sensors.

The best answer is a drone, especially if you want precision and a reasonable price.

Satellites tend to generate data and images that are too

low in resolution to be useful for precision weed management, especially for the five to 10 acre fields common in the Mississippi Delta region. In addition, clouds can obstruct the view of a particular field just as the satellite passes over. Data from aircraft, which typically fly at altitudes of 1000 feet or higher, cannot distinguish between crops and weeds, let alone GR and non-GR weeds. Ground-based sensors can provide the needed level of resolution, but they have to be moved from place to place within a field. That takes time and can be limited by the field conditions, according to Yanbo.

Travelling between too high and too close, drones fly under the clouds and in almost any weather.

“Last year, we could only fly our drone and capture data on dry, sunny, windless days. This year, we have a bigger drone and a better camera, and we have been able to fly even on really wet or windy days,” said Yanbo.

The new cameras Yanbo added this year record both narrow-band multispectral and hyperspectral imagery, which has increased accuracy regardless of the conditions.

Multispectral imagery is produced by sensors that measure reflected energy. In this case, the energy is reflected from each plant within four bands of the electromagnetic spectrum (gamma rays through visible light to radio waves). The four bands are visible green, visible red, red edge, and near infrared.

Hyperspectral imagery, in contrast, consists of data measured in as many as 150 narrower bands, each only five nanometers wide.

Together, they provide an incredible capacity to see that which cannot be seen by the human eye.

The types of sensors drones can carry continue to expand, and their flight capabilities continue to grow. They can be programmed to fly following a GPS map of crop rows or field borders.

Once the data from a drone run is downloaded and analysed by the algorithms Yanbo has developed, a GR weed registers as having a slightly different leaf pigment than a non-GR weed on an image of the soybean field.

One downside to using drone technology is the 2016 Federal Aviation Administration (FAA) regulation that requires drones to remain within the unaided sight of an operator or visual observer. That limits the size of the fields drones could be used to monitor.

Right now, Yanbo is still developing his drone-based system as a research tool to better understand the evolution of GR weeds.

## Farm use and precise pesticide application

“We will eventually develop a tool from this that could be used for farms,” Yanbo says.

When that time comes, Yanbo envisions that the data-gathering drone or a map of its results could be paired with a drone carrying herbicides. The herbicide-carrying drone might be automatically directed to deliver its chemicals with pinpoint accuracy. Glyphosate would only be applied to the susceptible weeds, a different herbicide would be applied only to the GR weeds, and no herbicide at all would be applied to nonweed plants.

“Precision herbicide application would benefit the farmer and the environment,” Yanbo points out. ■



ARS agricultural engineer Yanbo Huang (left) and technician Ryan Poe use a drone to identify glyphosate-resistant weeds in a Mississippi soybean field.



# A world without food animals?

■ By Dennis O'Brien, ARS – USDA

**W**HAT would happen if farmers stopped producing animals for food and everyone went vegan? Some have called for a move in that direction to address increasing concerns about health, eating habits, and climate change. Researchers at USDA's Agricultural Research Service (ARS) and Virginia Tech recently explored those questions in the US context and found surprising results.

Mary Beth Hall, an ARS animal scientist at the US Dairy Forage Research Center in Madison, Wisconsin, and Robin White, a professor of Animal and Poultry Science at Virginia Tech in Blacksburg, found that shifting land usage from food animal production to food crop production would increase the total US food supply by 23 per cent.

Because much of that land is unsuitable for high value crops, most of the additional food produced would include high-calorie crops like corn and soybeans.

## Major nutritional challenges

A complete shift away from food animal production would present major challenges to meeting America's nutritional needs. With no meat, milk, eggs, fish, or cheese in our diets, the US population would not receive enough of several different essential dietary nutrients from the foods they eat, according to the study results. The findings are based on information compiled in the USDA dietary guidelines.

"Different types of carefully balanced diets – vegan, vegetarian, omnivore – can meet a person's needs and keep them healthy, but this study examined balancing the needs of the entire nation with the foods we could produce from plants alone. There's a difference between what's possible when feeding one person versus feeding everyone in the US," says Mary Beth.

Eliminating food animals would increase deficiencies in calcium, vitamins A and B12 and some important fatty acids. The last are important as they help to reduce cardiovascular disease and improve cognitive function and vision in infants. Animal food products are the only available, non-supplemental sources of some fatty acids and vitamin B12.

A plant-only diet also would require individuals to eat more food and more daily calories to meet their nutritional needs from the foods they eat because the available foods from plants are not as nutrient dense as foods from animals.

## Reduced greenhouse gas emissions, but...

Agriculture in the US contributed to approximately 9 per cent of the nation's total greenhouse gas emissions in 2015, with nearly half of that total coming from animal production, according to Environmental Protection Agency (EPA) reports.

The scientists determined that eliminating food animals from US production would reduce greenhouse gas emissions, but not by the full 49 per cent of agricultural emissions by 28 per cent.

That would represent a drop of only about 2.6 per cent of total US emissions.

The findings were published in Proceedings of the National Academy of Science (PNAS).

For more information contact Dennis O'Brien, ARS Office of Communications  
Ph: +1 301 504 1624; Email: dennis.obrien@ars.usda.gov ■

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# Speaking 'farmer' the key to encouraging practice change

**I**MPROVING the uptake of Australia's world-class research and development (R&D) will require greater consideration of farmers' attitude to change, along with a range of other barriers to adoption, says a new report recently released by Nuffield Scholar and grain grower Chris Reichstein.

Chris owns and operates a 4500 hectare grains enterprise north-east of Esperance in Western Australia and received a Nuffield Scholarship supported by the GRDC.

His research investigated how best to deliver scientific information to farmers in order to effect practice change and improve profitability and sustainability. He also looked at international R&D models to bridge the gap between researchers and farmers to improve the performance of the agricultural sector.

Chris said his study topic was inspired by a long history of innovation by Esperance region growers faced with land clearing,

high input production systems, the implementation of no-till cropping and precision agriculture.

"Esperance was settled by farmers in the 1960s, who were lured by the promise of cheaper land and opportunity. With that, there's always been a strong undercurrent of risk-taking and progressive practice, which has led to early adoption in the area," Chris said.

"Today, as growers in the 21st century, we're facing a number of challenges such as climate and market variability, increased exposure to biosecurity threats and a general need to produce more, with less.

"I've always wanted to build understanding of what brings about change and how farmers learn to better their practices and, for me, the Nuffield Scholarship was the perfect opportunity to pursue this area of interest."

## Identify the barriers

The scholarship took Chris around the world not only to examine different R&D models, but also to identify some of the key barriers to adoption.

"Australia is home to some of the world's best R&D especially in agriculture, but has typically embraced the 'top down' model, which tends to be supply driven and directed by those off-farm like scientists and external organisations," he said.

"There's potential to explore other models like the 'bottom up' approach, which involves local farmers working collaboratively with public or private institutions, and lends itself toward being demand driven.

"One of the key findings of my report was that individual farmers are perhaps the greatest variable between enterprises when it comes to the financial and physical performance of a farm and that variations in behaviour can be based on past experiences right through to different personalities.

"So, having a more tailored and multi-pronged approach to packaging and delivering research could result in greater adoption on-farm and provide stronger return on investment.

"Furthermore, greater awareness into the impediments to adoption, be they cultural, economic, social, political or legislative, is absolutely critical and could bring a wealth of benefits to the agricultural sector."

Chris notes in his report that extension is an inexact science and to be effective should take into account different adult learning styles with a greater emphasis on peer-to-peer exchange.

"At its core, agriculture is incredibly diverse especially when it comes to research," he said.

"Learning about the latest in R&D shouldn't be a one-size fits all approach. It needs to be delivered to growers in a multitude of ways including face-to-face, written and online education.

"There's a growing trend to facilitated peer learning via grower groups – a key characteristic of the 'bottom up' model – which play a vital role in bringing together farmers and researchers for mutual benefit.

"It encourages farmers to share ideas and knowledge at the grower level and, when combined with benchmarking and formal advice from farm consultants, can be a powerful driver of practice change."



Nuffield Scholar and grain grower Chris Reichstein.

Contact Chris on 0429 101 970 or E: creichstein@bigpond.com



# Three reasons to use new adjuvant to boost summer knockdowns

**O**UTRIGHT 770 is the latest adjuvant developed by Vicchem to boost the performance of glyphosate in hard water conditions as well as offering an effective weed penetrant.

This unique 3 in 1 formulation provides genuine cost-effective benefits to growers – no handling of ammonium sulphate bags, a stable emulsion in a tank mix along with an excellent penetrant targeting hard to kill summer weeds.

Vicchem developed the innovative Outright 770 formulation in response to grain growers sharing their experiences with us concerning problems with hard water and harsh spraying conditions.

Along with efficacy, speed and ease of use are becoming key issues, especially for large-scale grain growers looking to save time and effort while refilling spray rigs during extra busy times.

One such grower is Neville Reilly of 'Moallaack' near Dilpurra, New South Wales, who tried Outright 770 for the first time last year.

"We needed to control a range of weeds in a few paddocks in summer so opted for a tank mix of glyphosate and Garlon," said Neville who bought a 1000 litre bulk container from his local reseller.

"We added Outright 770 to ensure good coverage and weed penetration – and avoid having to lug bags of ammonium sulphate into the spray hopper," he said.

"It was cost effective and the spray results were consistent, but the speed and ease of use also meant a reduction in downtime.

"Outright combines all the essential ingredients into a single blend which saves time during refilling. With no heavy lifting, it also saves our backs.

**FIGURE 1: When applying summer knockdowns, grain growers should choose the right adjuvant for the spray water hardness**

	<b>HOT-UP</b> SPRAY ADJUVANT	<b>OUTRIGHT 770</b> SPRAY ADJUVANT	<b>OUTRIGHT 770</b> SPRAY ADJUVANT + <b>ASSERT</b> WEED KILLER - SPREAD ADJUVANT
Water hardness rating	Soft to Moderate	Hard	Very Hard to Extreme
Hard water ions	Up to 500ppm	Up to 750ppm	Up to 3000ppm
Use rates	250-500mL / 100L	250-500mL / 100L	500mL / 100L + Assert as per label

"In terms of farm logistics, it makes the job of spraying a lot simpler, especially for us given our cropping program is scattered across several locations," he said.

Fifth generation farmers, Neville and his brother Richard grow a range of crops including wheat, barley, canola, lentils, chickpeas, lupins and vetch at 'Moallaack' and another property near Corack in the Victorian Mallee.

Farm chemicals are applied with a self-propelled CaseIH Patriot 4430 with a 36 metre boom which operates at 20–25 km per hour, covering 80–100 hectares every hour.

An active member of the Birchip Cropping Group since its inception, Neville said the progressive grower network had conducted many crop agronomy trials over the years, including trials to evaluate spray adjuvant types and rates.

"The fact that Vicchem has been a sponsor of the group for some years now is another good reason to support the company," he said.



Neville Reilly added Outright 770 to a tank mix of glyphosate and Garlon to control a range of summer weeds and conserve soil moisture in advance of sowing winter crops.



The self-propelled CaseIH Patriot 4430 applying herbicide to a young lentil crop at 'Moallaack' near Dilpurra in July 2017.

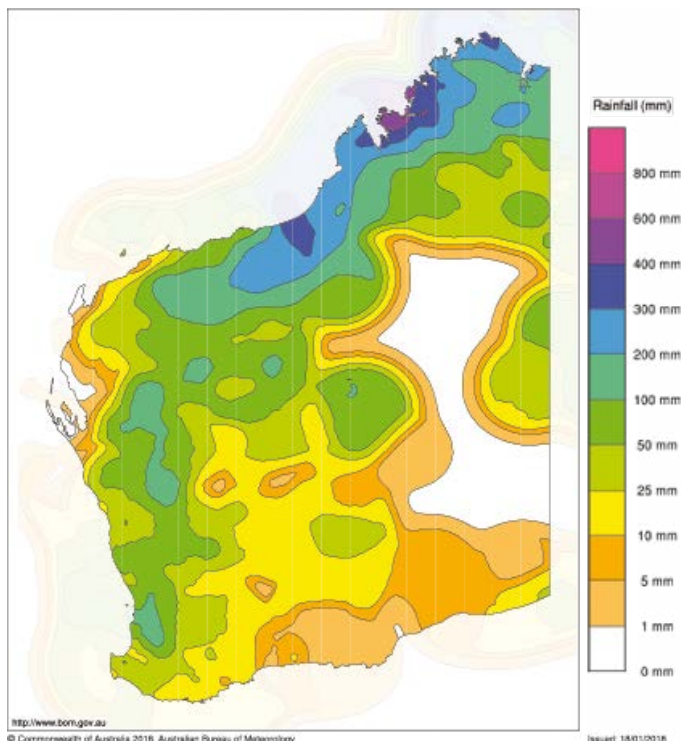
# District Reports...

January–February 2018

## Western region

Western Australia rainfall totals (mm) January 1–18, 2018

Australian Bureau of Meteorology



## WESTERN AUSTRALIA SUMMARY

As the 2017 winter crop harvest progressed across Western Australia, there was an encouraging increase in the estimate of total grain tonnage to nearly 13.5 million tonnes. This was higher than earlier forecasts due to most paddocks yielding better than they previously looked.

Wheat and barley crops in the West Kwinana, South East Kwinana, Esperance, Lakes District and Albany zones all yielded higher than expected. The impact on cereals from the late rains in September – and very mild temperatures during October – combined to push most cereal grain yields to above average for these areas.

Cereal grain weights were exceptional and influenced the extra tonnes growers harvested.

Despite the extra tonnage, most wheat and barley crops struggled to make the higher priced grades due to low protein content. The low protein grain is a result of lower than normal fertiliser use from the late start to the season and dilution from extra yield.

### Canola production also surprised

Canola harvest tonnage also increased from the November estimates by around 33 per cent across the state due to a greater area than expected in the north being harvested.

Whilst yields were variable in the southern areas, the higher yielding paddocks pushed grower averages above forecasts.

The exceptional canola yields in the Esperance, West Kwinana and Albany zones were the main contributors to this increase in estimated tonnages.

It is also obvious now that the predicted extra area sown to canola at the start of the year was accurate and the extra opportunistic paddocks that were sown by many growers has added up across the state to contribute to this extra tonnage.

GIWA gratefully acknowledges the support of DPIRD and contributions from independent agricultural consultants and agronomists in the production of this report.

GIWA Crop Report – December 7, 2017

## SOUTH COAST

Seasonal conditions have been dry over the South Coast for the past two months with very little summer rain – as a result there's been minimal spraying activity.

The 2017 winter harvest was wrapped up for most by mid December. Yields were generally very good with the Esperance



Road-trains lined up at the CBH Chadwick site (Esperance) waiting to deliver grain from a very good 2017 season. The Chadwick site was briefly closed due to a bad thunderstorm on November 18

## WESTERN AUSTRALIA 2017 WINTER CROP PRODUCTION (tonnes) – GIWA estimates at December 7, 2017

Port zone	Wheat	Barley	Canola	Oats	Lupins	Field pea	State total
Kwinana	3,430,000	1,480,000	585,000	280,000	160,000	22,000	5,957,000
Albany	1,420,000	995,000	520,000	215,000	54,180	4,000	3,208,180
Esperance	1,380,000	870,000	530,000	10,230	21,200	20,300	2,831,730
Geraldton	1,145,000	54,000	135,000	3,000	145,000	600	1,482,600
<b>Totals</b>	<b>7,375,000</b>	<b>3,399,000</b>	<b>1,770,000</b>	<b>508,230</b>	<b>380,380</b>	<b>46,900</b>	<b>13,479,510</b>
<b>% change to Nov 2017</b>	<b>7.0%</b>	<b>7.1%</b>	<b>33.2%</b>	<b>0.0%</b>	<b>2.0%</b>	<b>0.0%</b>	<b>9.4%</b>

Note: The grain totals reported are for whole farm production. This includes on-farm seed and feed requirements as well as trade outside of the CBH network.



# District Reports...

January–February 2018

port zone delivering 2.8 million tonnes of grain to CBH. Grain quality was also very good with lower protein levels being the main concern.

On many farms, nitrogen application rates will have to be revisited or more legumes will need to be introduced into the rotation.

Current farm activities include the usual summer jobs of spreading lime and gypsum, deep ripping, clay spreading and delving. There's also been some surface drainage work carried out.

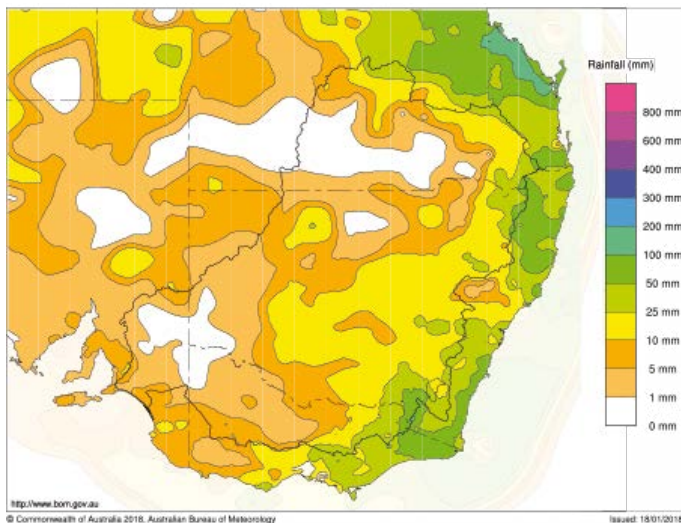
The weather has been very good for taking advantage of the South Coast's beautiful white sand beaches and crystal clear water – just the tonic to recharge the batteries for the 2018 season challenges ahead.

**Quenten Knight**

**Agronomist, Precision Agronomics Australia, Esperance**  
January 19, 2018

## Southern region

**Murray–Darling Basin rainfall totals (mm) January 1–18, 2018**  
Australian Bureau of Meteorology



## NSW OVERVIEW

November rain improved 2017-18 summer crop conditions, with 20 per cent of NSW receiving above-average rainfall. The above-average rainfall occurred across the far south west, Murray Valley, south east and scattered areas of the north west, far north coast and south west slopes. Thunderstorms were common, due to easterly winds feeding moist tropical air across the state.

The rainfall encouraged further sowing of sorghum, and increased interest in other summer crops such as mungbeans and sunflowers. These crops are now in need of good rainfall.

The winter crop harvest across the north west slopes and plains was virtually completed during November. The October–early November rainfall improved yields of later maturing winter crops across the south east, central west slopes, south west slopes, Riverina and Murray Valley.

Yields were generally greater than expected, compensating to some extent for the extremely dry winter conditions. Protein levels of wheat were high and grain quality generally good from crops harvested before the late November rain.

Canola oil content was variable, with lower contents in the western areas.

The winter crop harvest continued across the central and southern slopes of NSW during November and into December, although the late rainfall received resulted in some damage to crops and quality downgrading.

**NSW Department of Primary Industries**

## Northern region

### LIVERPOOL PLAINS

The Liverpool Plains had a generally very dry winter crop harvest period with a few small rain events causing a surprising amount of quality downgrades to chickpeas. Overall, we saw crops come off in record time.

It seems to be pretty common that there is a trade off between yield and quality. For the 2017 season, for most Plains growers, quality outweighed the yield.

Chickpeas did well on long fallow but struggled on short fallow while there was mixed results at sampling stands after a rain event disrupted harvest. Some loads were sent home with mildew evident in samples.

The summer crop is in but it's looking hard for a decent rain.



**The 2017 chickpea harvest underway at "Tipa-Hootti" near Premier on the Liverpool Plains. Below average growing season rainfall saw crops planted into long fallow paddocks performing much better than short fallow.**



# District Reports...

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There has been only isolated storms and we have received our share of 35° plus temperatures. Rain is needed very soon if we are to achieve our targeted dryland yields.

But irrigated crops are looking good if you can keep the water up to them.

## Activities on our farm

Chickpeas were harvested back in December with yields being greater than expected. This was put down to good moisture at the start of the growing season and excellent crop establishment with even spacing. Our precision planting set-up was the reason for this – we achieved great plant spacing and uniformity which allowed the crop to yield well despite the lower than average growing season rainfall.

The only bonus of the low growing season rainfall was that fungicide was applied only once.



Dryland cotton on the Liverpool Plains is desperately in need of a drink but irrigated crops are going well – if you can keep the water up to them.

We are currently spraying weeds on the fallow country and hoping for good summer rainfall to increase stored moisture for the winter crop.

**Lauren McGavin**  
**Precision Seeding Colutions Premier**  
**January 17, 2018**

## DARLING DOWNS

The weak La Niña has not brought the anticipated general rain to the region, and after the good start in October, crops are starting to show moisture and heat stress. December delivered some rain but it was varied, and the Colonsay area was hit with hail for the second time in two years.

The Boxing Day storm damaged around 4000 hectares, with 1000 hectares of crop totally killed, along with infrastructure damage.

## Summer crop

The early sorghum crops are well into grain fill with some approaching desiccation, and these should yield reasonably at around 4 plus tonnes per hectare. But most of the district's sorghum is at early grain fill and needs a drink to reach its potential. There are also some December planted crops about.



The biggest summer pests of this sunflower crop at Felton on the eastern Darling Downs have been photographers!



A Boxing Day storm wreaked havoc to corn (pictured) and sorghum crops in the Colonsay area.



# District Reports...

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Helicoverpa pressure has been varied as egg-laying by moths has not been consistent – so not all crops have needed insecticide control. Midge numbers are low so far but Rutherglen bug numbers are starting to build up.

Corn is growing well, with most crops under irrigation and at early grain fill to the start of dry-down. These crops are mainly for the processing or silage markets. The December storms have also led to January corn plantings, but the spring-planted dryland crops are stressing now.

Dryland cotton is starting to struggle with moisture stress at peak flowering, and crops will be suffering by the end of January if no relief comes. Irrigated cotton crops are between early flowering and first cracked boll, have had two irrigations and will need at least two more. Insect pressure on cotton has been quiet but mirid numbers are starting to increase.

The summer plant of mungbeans has been reduced because of areas missing out on planting rain as well as a lower price outlook. But the crops that are in are establishing fairly well. There were some spring plantings of mungbeans to the west, and those that received about 50 mm at early podding are yielding well at around the 1.5 tonnes per hectares mark.

The soybean crops this summer are mostly irrigated and growing well and are at the early vegetative stage.

A healthy area of sunflowers has been planted on the forecasts of good prices. The early crops are at full flower to grain fill. Pest activity has been light apart from those prettier crops attracting high numbers of photographers!

## The outlook

If rain does not fall before the end of January, summer crop yields will decrease.

The fallow paddocks are also very dry, and good rain is needed to build up the moisture profiles for the winter crop. It is expected this winter's plantings will be more focussed on wheat and barley at the expense of chickpeas, due to projected prices.


**Hugh Reardon-Smith**  
Agronomist – Landmark, Pittsworth  
January 19, 2018

## CENTRAL QUEENSLAND

The 2017 winter harvest in Central Queensland was in the bin by late November. During September wheat and chickpea harvest was already underway and progressed well with very few weather interruptions. Early October did bring some rain delays.

The mild winter together with high temperatures in late August – plus a few reports of frost – helped to bring the harvest period forward.

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

<i>Brought to you in association with</i>  <b>JOHN DEERE</b>	<b>Summer</b>		<b>Autumn</b>		<b>Winter</b>		<b>Spring</b>	
	25yr Annual Average (mm)	2018 rainfall to date (mm)	25yr Annual Average (mm)	2017–18 to date	25yr Annual Average (mm)	2017	25yr Annual Average (mm)	2017
Emerald Qld	561	16	251	98	105	224	69	16
Toowoomba Qld	675	4	269	108	138	348	88	64
Roma Qld	581	0	251	83	116	183	78	40
Goondiwindi Qld	623	0	254	52	122	148	102	54
Narrabri NSW	631	1	220	39	118	231	130	73
Gunnedah NSW	634	13	217	80	108	138	129	74
Dubbo NSW	604	13	190	67	127	237	133	33
West Wyalong NSW	454	5	119	123	80	109	124	75
Wagga Wagga NSW	540	23	133	124	111	87	150	105
Swan Hill Vic	317	3	71	56	65	132	87	68
Bendigo Vic	504	2	109	39	106	187	159	124
Horsham Vic	374	10	79	36	71	120	122	114
Lake Bolac Vic	515	4	114	51	101	143	153	119
Murray Bridge SA	364	3	70	53	79	83	121	102
Kadina SA	336	4	63	46	78	43	112	71
Cummins SA	388	0	55	26	88	25	170	164
Esperance WA	614	1	88	17	141	108	248	219
Wagin WA	397	30	50	46	97	77	163	163
Northam WA	401	75	47	90	88	41	185	169
Mingenew WA	347	54	30	57	89	29	170	108
Moora WA	382	58	43	75	85	32	185	200
Mullewa WA	321	45	53	70	93	11	130	134

Last rainfall reading January 17, 2018.



# District Reports...

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A well grown chickpea crop next to a maturing wheat field in the Emerald district. The photo was taken in early September, 2017.



Thanks to reasonably good rainfall, 2017 wheat variety trials performed well near Jambin in the Callide Valley.

Drought-like conditions in the Central Highlands from May to the beginning of October 2017 impacted on winter crop yields. But there was a bit of relief with rainfalls in the Callide and Dawson Valleys of 50–75 mm and 25–50 mm respectively.

Heavier rainfall of 100–200 mm in October also impacted harvest for many growers in the Southern Highlands and eastern river valleys.

As a result wheat yields on the Central and Southern Highlands were below average to average due to the dry growing conditions and warm temperatures.

But yields in the Northern Highlands (Kilcummin) were average to above average thanks to autumn rain. Yields were also above average in the Callide Valley with a wetter growing season.

Overall quality was generally good with limited screenings and higher proteins.

Similarly, chickpeas yields were average, but generally of an excellent quality and attracted high prices at around \$700 to \$1000 per tonne for chickpeas harvested prior to the October rainfall. Chickpeas harvested later suffered some weathering resulting in reduced quality and low level moulds – but generally passing delivery standards.

For cotton, the 2017-18 season started positively with young crops powering along after the October rain. This rain also created a planting opportunity for dryland cotton growers.

**Max Quinlivan**

**Department of Agriculture and Fisheries, Emerald**



Drought conditions in the 2017 winter resulted in below average wheat yields in the Capella district.

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