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FRONT COVER



Man vs Plant:

When it comes to using light energy, how do manmade photo cells compare to plants' photosynthesis? See article Page 4.

(Photo courtesy of Institute for Genomic Biology/University of Illinois.)

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In my November–December editorial I suggested that there might just be a few 2011–12 winter crop production surprises in store after the headers have had a chance to chew their way through 22.5 million hectares of wheat, barley, canola and other winter crops. Across the nation, spring conditions were generally favourable and most regions were able to harvest without too many weather delays. The upshot of at least a few of the farming planets aligning, has been the delivery of our largest winter crop on record.



In mid December, our official government forecaster ABARES, revised their September 2011 estimate upwards by almost six per cent to 43.42 million tonnes. This just pips the previous Australian winter crop record of 43.39 mt harvested in the 2003–04 season.

Western Australia led the charge last year with a stunning 82 per cent lift in production from the drought-affected 2010–11 crop. Around 14.7 mt is expected to be the final tonnage in WA while production in the eastern states (including South Australia) is estimated to have fallen by 16 per cent compared to the 2010–11 season.

But the forecast delivery of 28.7 mt from last season will still be the second largest winter crop production in the eastern states on record.

With the relatively high yields – along with depleted soil nitrogen reserves following the big 2010 crop – grain quality and protein levels will be back a cog but there's plenty of grain to sell.

Our very strong Aussie dollar is not doing us any favours in terms of domestic grain prices. With our national grain bins filled to the brim, an AUD/USD exchange rate of around 75 cents – instead of the current better than parity – would leave us very little to complain about.

Summer crop records in the offing as well

The current summer crop area is estimated at 1.5 million hectares. Plenty of irrigation water, good subsoil moisture levels in the northern region and strong cotton prices are behind this biggest planted area for a decade. ABARES has forecast that total summer crop production will increase by around 18 per cent on last summer to 5.4 million tonnes.

Farm study tours for 2012

There's been a lot of hard work and very good management gone into these record production results. Enjoying one of our farm study tours this year would be just the way to pat yourself on the back. Our four main tours this year are:

- North America & Canada (including the 100th year of the Calgary Stampede);
- Cambodia, Vietnam, China & Tibet Asian Odyssey;
- Mediterranean/Southern Europe; and,
- South Africa & Argentina (with a bit of Test rugby thrown in).

Contact the office on 07 4659 3555 for more details or visit: www.greenmounttravel.com.au



In this issue...

Man or plant? Finding the best users of light energy

When it comes to using light energy, how do manmade photo cells compare to plants' photosynthesis? An Agricultural Research Service scientist participated in a study comparing how efficiently plants and photovoltaic cells convert sunlight into energy.



See article Page 4

Boom times – you'd better believe it

There is far more money in farming than most people imagine and the big winners in the near future will be farmers themselves, agricultural service providers and their rural communities.



See article Page 16

Preserving a new herbicide for future generations

This article outlines AHRI's research in assessing the potential for resistance to the new herbicide Sakura to evolve in the major Australian weed species, annual ryegrass. This research is a world first in that the resistance evolution risk has been evaluated in a herbicide prior to its commercial release.



See article Page 30

Hofherr-Schrantz-Clayton-Shuttleworth

To most unenlightened non-tractor folk, the above name is probably suggestive of either one of these incomprehensible menu selections with which one is confronted in a typical yuppie Little Collins Street restaurant, or some weird cocktail also available in one of the aforementioned establishments. In the back paddock, were once again harnessed to the plough.



See article Page 21

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Man or plant? Finding the best users of light energy

■ By Sharon Durham, Agricultural Research Service – USDA

WHEN it comes to using light energy, how do manmade photo cells compare to plants' photosynthesis? An Agricultural Research Service scientist participated in a study comparing how efficiently plants and photovoltaic cells convert sunlight into energy. The study, published in *Science*, could help researchers improve plant photosynthesis – a critical first link in the global supply chain for food, feed, fibre, and bioenergy production.

Comparing the two systems is a challenge. Although both processes harvest energy from sunlight, they use that energy in different ways. Plants convert the sun's energy into chemical energy, whereas solar cells produce electricity.

Scientists know that plants are not as efficient as manmade solar cells at converting light into energy, according to research leader Donald Ort in the ARS Global Change and Photosynthesis Research Unit in Urbana, Illinois. "But now we have a way of comparing the two systems more accurately," he said. The study identified specific redesigns that hold excellent promise for improving efficiency.

To facilitate direct comparison between photosynthetic and solar cell systems, the researchers set a uniform basis for the comparison and examined the major factors that define the efficiencies of both processes – first considering current technology, then looking forward to possible strategies for improvements.

In all cases, the research team considered the efficiency of

harvesting the entire solar spectrum as a basis for comparison. Additionally, the researchers compared plants to solar cell arrays that also store energy in chemical bonds.

Calculations were applied to a solar cell array that was coupled to an electrolyser that used electricity from the array to split water into hydrogen and oxygen. The free energy needed to split water is essentially the same as that needed for photosynthesis or a solar cell, so the comparison is on a level playing field.

Potential to improve nature

Using this type of calculation, the annual averaged efficiency of solar cell-driven electrolysis is about 10 per cent. Solar energy conversion efficiencies for crop plants are about one per cent, which illustrates the significant potential to improve the efficiency of the natural system.

"While, in the context of our efficiency analysis, solar cells have a clear advantage compared to photosynthesis, there is a need to apply both in the service of sustainable energy conversion for the future," says Don. "Our ultimate goal is to design food and biofuel crops that use sunlight energy more efficiently and are thus higher yielding. This energy-efficiency analysis between plant photosynthesis and solar cells will lay the groundwork for improving the efficiency of plant photosynthesis in agriculture for improved yield."

Donald Ort is in the USDA-ARS Global Change and Photosynthesis Research Unit, 1206 West Gregory Dr., 1500 IGB, Urbana, IL 61801; PH: +1 (217) 333 2093. ■



Research leader Don Ort inspects a switch for a device that allows him to adjust a variable in the soybean field. (Photo courtesy of Institute for Genomic Biology/University of Illinois.)



In studies at Urbana, Illinois, ARS scientists (left to right) Carl Bernacchi, Don Ort, and Lisa Ainsworth work in a facility where photosynthesis efficiency and yield can be measured in response to a simulated variable. Improving photosynthesis could lead to increased food production from soybeans, shown here. (Photo courtesy of Institute for Genomic Biology/University of Illinois.)

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New technology seeks weed control savings

VICTORIAN graingrower Russell Hocking is in no doubt about the wisdom of his recent investment in the latest weed control technology. "It's incredible," he says, "I can relate it to the innovation of autosteer. *WeedSeeker* does exactly what they say it's supposed to do. We'll save 80 per cent of chemical in some paddocks."

The latest generation of weed detection technology is set to considerably reduce herbicide costs for broadacre farmers.

The technology behind this development has been available for the last couple of decades, was commercialised in the US in the mid nineties and has since found global commercial applications to selectively apply herbicides, insecticides, fertilisers and fungicides to plants in agricultural, horticultural, viticultural and industrial situations.

Crop and weed sensing technology has existed as a research tool in Australia since 1984. The concept was originally developed by researcher Warwick Felton at the DPI Tamworth in NSW. It is particularly applicable to Australian cropping conditions and is now being adopted by progressive farmers here.

Weed detection technology is used for summer weed spraying, couch grass and knockdowns for a range of weed sizes and will also help minimise glyphosate resistance. NSW DPI research in northern NSW has shown that the average weed cover in fallow paddocks is as low as 20 per cent of the paddock area. This means that often 80 per cent of the herbicide is applied to bare soil and is wasted.

Targeting just the weeds

The systems available now in Australia combine extremely accurate, rapid weed recognition technology and fast-acting solenoids linked to spray nozzles to spray only the weeds efficiently at speeds of up to 25 kph.

Light emitting diodes (LEDs) mounted on the spray boom

produce a combination of infrared and red light which is projected onto the ground approximately 600 mm to 800 mm below the sensor. The light reflected from the target is captured by a detector at the front of the sensor.

All plants contain chlorophyll and absorb more red light than infrared light. Sophisticated electronic circuits inside the sensor analyse the reflected light and determine when it matches the light reflected by the green plants.

When a weed is identified, it triggers a solenoid valve which sprays the plant.

On-farm application

Russell and Sharon Hocking crop 3000 hectares at 'Milloo', just east of Rochester in central Victoria.

Their cropping mix includes canola, wheat, barley and oats and vetch hay for export.

They purchased a *WeedSeeker* set-up in September 2010 from Southern Precision Pty Ltd, based in Naracoorte South Australia. Southern Precision has been selling the technology since 2006.

"But," as Russell explained, "it was probably not the best year to start with the *Weedseeker* – if we'd had it through the previous three summers it would definitely have paid for itself."

To set up for weed detection, Russell bought a second-hand 24 metre GoldAcres Ground Glider. Southern Precision fitted the *WeedSeeker* system onto the boom, with an 800 litre tank and its own spray pump. At the same time they bought a new GoldAcres trailer with a 6500 litre chemical tank and three direct chemical injection units.

They pull the rig with a John Deere 8225R.

The boom is fitted out with twin spray lines and 64 solenoid/nozzle units. Russell said that the spacing between the camera and the nozzle is critical.

The twin spray line set-up is run simultaneously – the larger tank doing a blanket spray of light chemical for the small weeds and the *WeedSeeker* targeting the larger weeds. It also gives them the choice to run two different chemicals.

In 2011 Russell mainly used Roundup, Surpass and Garlon through the 800 litre tank and topped it up via the large tank.

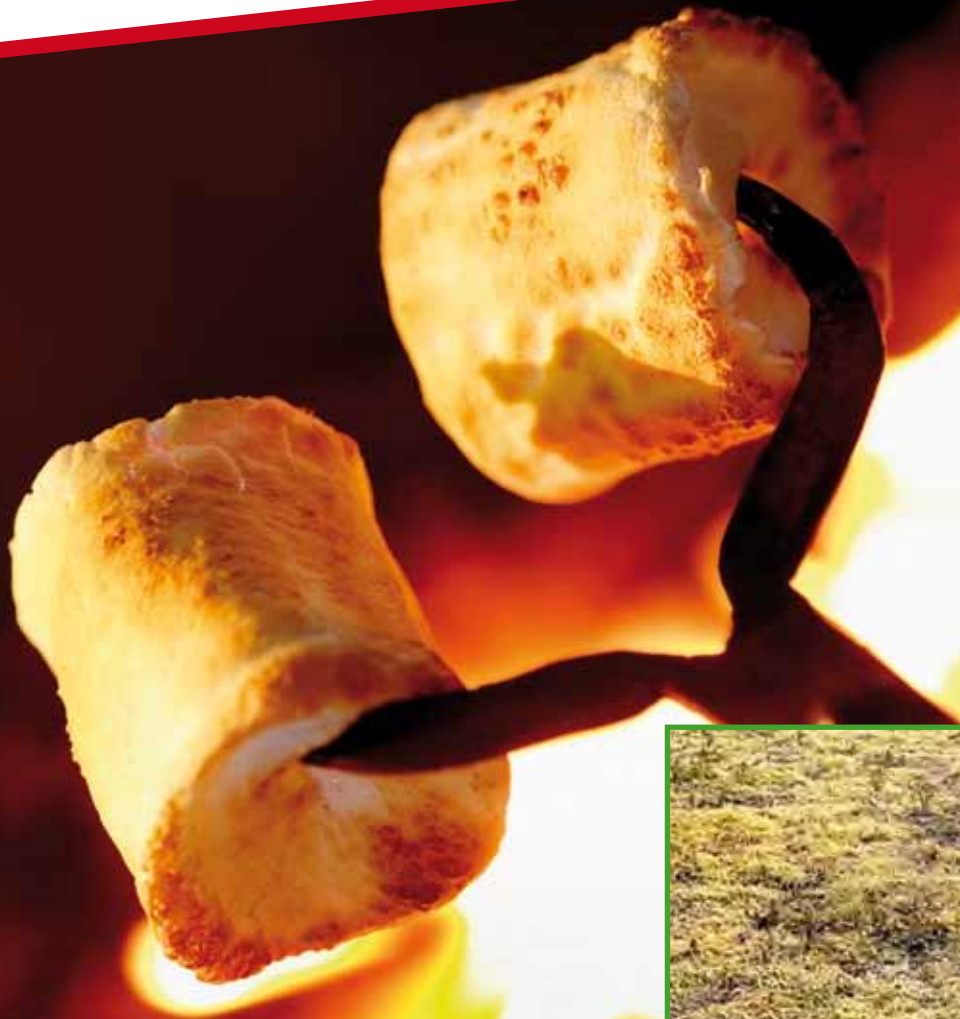


Russell Hocking, 'Milloo', says that there are many benefits from using weed detection technology.



The *WeedSeeker* sensor/solenoid/nozzle units mounted on Russell Hocking's GoldAcres Ground Glider.

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Cost savings were the key

"Saving money on chemical was the main issue behind purchasing the *WeedSeeker* system," he explained. "A few years ago we were spending \$90,000 a year on chemical. It was a simple sum to do."

With the wet start to 2011 all sizes of weeds had been coming up continually.

"At the first spray you'd save about 10 to 15 per cent of the chemical. "It's with the second and third sprays that you get the big savings. It's child's play to use – an on-off switch and the calibrator. The slower the better for efficiency, but it usually runs at 18 kph."

LED lights fitted to each sensor unit along the boom light up as the nozzle is activated. As Russell says, "it's amazing; it's like a party going on back there."

He says that there is a downside; the unit may need to be recalibrated for each paddock. "But that's pretty simple. You park it on a patch with no weeds, hit the calibrate switch and it sets the standard that it will operate to. On some paddocks you need to use the sensitivity switch. You calibrate for the lighter soils and the darker soils are more sensitive."

In the 2010–11 summer, spraying 3000 hectares, they found that the savings in chemical in the different paddocks varied from very little to 50 per cent.

But Russell has found other benefits: "The farm ends up very clean. For example, we get Bathurst burrs here that are usually not enough to spray for, but too much to cut. We just go and

spray them with the *WeedSeeker*. Plus we have a marshmallow problem that is usually very expensive to fix. *WeedSeeker* picks it up well.

"It really is more efficient in more ways than one – we can go all day on one tank of chemical, and reduce refilling time, labour and fuel."

Weed detection technology also helps in reducing off target drift.

An early adopter

When Russell was researching the purchase of the *WeedSeeker*, he visited Steve Lanyon at Catumnal, just west of Boort to have a look at the system in action.

Steve farms the 4000 hectare family farm with his father Trevor and in 2008 became one of the state's early adopters of the technology after seeing it on display at the Speed Field Days through Southern Precision.

They crop 3845 hectares with the majority being canola, plus barley, faba beans and lentils.

Steve built their own trailed boom to set up the *WeedSeeker* and tow it behind a John Deere 7920. With a 5000 litre main tank and 20 metre boom, it is set up to suit their controlled traffic system. The 52 sensor units have 15 inch spacings.

Like Russell Hocking's sprayer, they use two boom spray lines, one for a blanket spray, the other for the *WeedSeeker*.

Steve also says that the reason for their investment is simple. "At that time Roundup was \$15 a litre and we were spending \$84,000 on summer spray. The *WeedSeeker* is used mainly in summer, very rarely at other times. It works on all varieties of weeds and is excellent on melons and Bathurst burr."

Very economical for contracting customers

Steve says that the savings have been substantial. In the first year they saved \$48,000 on Trevor's farm. "It was costing us \$24 per hectare, now we've been saving 87 per cent of chemical use."

Steve has been contracting over the past two years and customers have been very impressed. "We saved one customer \$28,000 on one job," he said.

"So far we've done more than 120,000 hectares – we've had more problems with the boom itself than the technology of the *WeedSeeker*. This year we've been spraying at one litre per hectare through the blanket spray line and 750 ml per hectare through the targeted line.

"It all means that you can increase the rate of Roundup to minimise resistance. Hard-to-kill weeds like couch grass become easy."

More information about *WeedSeeker* is available from Grant Yates at Southern Precision on 08 8762 3316, or www.southernprecision.com.au



Steve Lanyon, Boort, is extremely happy with the savings in chemical through his *WeedSeeker* system.



The LEDs light up in action on Steve Lanyon's *WeedSeeker*-equipped home-made boom.



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Brome grass found to be resistant to glyphosate

■ By Chris Preston, AGSWG, University of Adelaide

A POPULATION of Great brome grass (*Bromus diandrus*) from South Australia has recently been confirmed resistant to the world's most important herbicide – glyphosate.

This is the first time that this highly competitive annual grass weed of crops and pastures has evolved resistance to glyphosate and is the third Australian weed species confirmed as resistant to glyphosate in the past 12 months. This highlights the need for growers to be on-the-lookout for any weeds that should be controlled by glyphosate but which survive.

The resistant brome grass was found surviving in a paddock where an old fence had been removed and cropped over and a pre-sowing application of glyphosate had been applied.

The fence line had previously been sprayed with glyphosate for many years with no other weed control tactics used.

This is a huge concern to Australian grain growers because this highly competitive weed has been becoming a major problem in reduced-tillage farming.

Currently the number of glyphosate-resistant ryegrass populations evolving along fencelines is exploding. That – and this new discovery – are a real 'wake-up call' and show that any weed might develop glyphosate resistance and growers need to be vigilant.

Brome grass background

Brome grass is a major weed of crop and pasture on lighter textured soils across the southern and western Australian cereal belts. In wheat, there are few effective in-crop herbicide options for this species, and it can reduce yields by 30 to 40 per cent. It also emerges after crop establishment enabling it to compete strongly with the crop and produce large amounts of seed.

Brome grass is also a host to a range of cereal crop diseases including take-all and barley net-blotch, while the mature seeds can injure stock. Populations of brome grass are already resistant to grass selective Group A and Group B herbicides in Victoria and Group B and Group C herbicides in Western Australia.

Fenceline management

Managing brome grass and other weeds along fencelines requires a diverse approach. Herbicides with different modes-of-

THE AGSWG

The Australian Glyphosate Sustainability Working Group is supported by the Grains Research and Development Corporation (GRDC) and key R&D-based crop protection companies with an interest in the sustainability of glyphosate. Its website has a range of information about glyphosate resistance including a register of glyphosate resistant weed populations and guides and links for management of glyphosate resistance in different crops and management situations.

action to glyphosate need to be included. On erosion-prone sites ground cover needs to be maintained so control along fences and firebreaks should take place late winter to early spring.

The older tactic of sowing crops to the fenceline, then baling and spraying an area along the edge of the crop for a firebreak, is a valuable way of stopping weeds moving into the crop while protecting the soil.

Management in winter cereals

The management of brome grass in winter cereals is complex and requires many different tactics to get weed numbers down and lessen the risk of developing herbicide resistance.

Which tactics are used will be determined by location, farming system and the farmer's aspirations.

Farmers need to use a rotation that enables a sufficient range of tactics to be used so that the weed seedbank can be driven down and kept low.

Tactics such as spray-topping, brown or green manuring, hay, crop competition and windrow burning are useful to take selection pressure for resistance off the herbicides.

If you suspect glyphosate resistant brome grass on your property, contact your relevant state expert. Details of who to contact in each state are available from the Australian Glyphosate Sustainability Working Group website: www.glyphosateresistance.org.au

The author, Associate Professor Chris Preston, is chair of the Australian Glyphosate Sustainability Working Group and is leader of the University of Adelaide team which confirmed the first case of brome grass resistance to glyphosate. ■



Glyphosate resistant brome grass (top row) and susceptible brome grass (front row) following application of 0 to 2 litres per hectare of glyphosate (left to right). (Photo: Chris Preston)



Brome grass infestation adjacent to a wheat crop. (Photo: Andrew Storrie)

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Australian Grain — 11

Avoid spray drift by recognising unsafe conditions

GRAIN growers are being encouraged to avoid pesticide spray drift by developing an understanding of weather conditions conducive to spray drift. Recognition of conditions that lead to a surface temperature inversion is particularly important as the potential for spray drift is high when this occurs, according to industry authorities.

Spray consultant Bill Gordon, whose work is supported by the Grains Research and Development Corporation (GRDC), says surface temperature inversions commonly develop overnight, when the ground loses heat and the low-level air cools.

"This results in air temperature increasing with height and the temperature profile is said to be inverted. When this occurs close to the ground it is called a surface temperature inversion," said Bill, of Bill Gordon Consulting, Lawrence (NSW).

"Unlike warm air that rises, cool air is dense and remains at the surface. Sprays applied in these conditions can become trapped in this cool air layer.

"Once trapped, unpredictable air movement can transport droplets away from the target area."

Meteorologist Graeme Tepper, of MicroMeteorology Research and Educational Services, said when surface inversions exist pesticides in the air can move long distances at high concentrations near the surface and adversely impact non-target receptors, often in directions and locations that could not be estimated from general weather patterns.

"The scientific method for detecting a surface temperature inversion requires the accurate measurement of the air temperature close to the ground and at a height of at least 10 metres," Graeme said. "On-farm, this is usually not practical, so most spray applicators must rely on visual clues."

Visual clues

Graeme said a surface temperature inversion does exist if mist, fog, dew or a frost occur, and smoke or dust hangs in the air and moves sideways, just above the surface. Other clues include cumulus clouds that have built up during the day collapsing towards evening, sounds becoming very clear at night and aromas becoming more distinct at night.

To assist growers with understanding how and when a surface temperature inversion occurs, the GRDC, with assistance from Bill and Graeme, has developed a Surface Temperature Inversions and Spraying Fact Sheet.

Research supported by the GRDC is further investigating the development and implications of temperature inversions in relation to spray application.

The Fact Sheet can be viewed and downloaded via www.grdc.com.au/GRDC-FS-sprayinversions.

Further information: Bill Gordon on 0429 976 565 or Graeme Tepper on 0429 309 508.



Under a surface temperature inversion air can separate into very stable layers (laminates) that can concentrate and transport airborne pesticides. (Photo courtesy Bill Gordon)

Twin sowing the seed for more mixed farming profits

FIONA Young's fourth year honours project, as part of her Agricultural Science degree at The University of Western Australia (UWA), assessed the economics of simultaneously sowing a hard-seeded annual legume pasture under a cereal or oilseed crop.

Although clearly exhibiting the potential to reduce pasture establishment costs, the innovative technique was yet to undergo a formal economic assessment.

"My research used a whole-farm bioeconomic model, known as MIDAS, combined with sensitivity analysis, to test the hypothesis that twin-sowing increases the profitability of mixed broadacre farming systems in WA's central grainbelt," Fiona said.

"My study revealed how and in what situations twin-sowing is likely to be highly profitable and where and when it's likely to be widely adopted."

More profit, less pasture

To assist her project she has been awarded the Sir Eric Smart Scholarship for Agricultural Research, which encourages bright students in UWA's Faculty of Natural and Agricultural Sciences to research ways of improving the productivity and profitability of wheat, barley, lupins or canola growing in WA's light soil types.

Fiona said the MIDAS model application showed that twin-



Sir Eric Smart Scholarship for Agricultural Research recipient, UWA Agricultural Science student Fiona Young, has assessed the economics of simultaneously sowing a hard-seeded annual legume pasture under a cereal or oilseed crop.

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sowing boosted whole-farm profit, while decreasing the area of farm optimally devoted to pasture.

"For a standard farm, the pasture area decreased by 13 per cent, while profit increased significantly by 24 per cent," she said.

"Twin-sowing increased an average farm's capacity to carry sheep by up to 24 per cent and eliminated initial nitrogen fertiliser requirements for crops following a year of legume pasture."

As twin-sowing has been developed mainly for pasture establishment on sandy soils, farms with predominantly sandy soils experience the largest increase in farm profits (41 per cent at current high prices for sheepmeat and wool).

"Sensitivity analysis suggests that even if current wool prices, pasture growth and sheepmeat prices decline, twin-sowing remains highly profitable compared to farming systems without this innovation. The combination of desirable characteristics of twin-sowing highlights its potential for further trial demonstrations and adoption across different farming systems," Fiona said.

In mixed enterprise dryland farming systems of southern Australia, sheepmeat and wool production relies on annual pastures often grown in rotation with phases of cropping.

According to Fiona, pasture phases are becoming shorter and livestock numbers dwindling, challenging farmers to recover costs associated with pasture establishment and maintenance.

New sheep opportunities

"Farm owners are therefore re-thinking crop-only farming systems, as they recognise the potential opportunities sheep can provide, especially in terms of lamb production, supported by the availability of non-wool sheep breeds such as Dorpers.

"This interest, however, is sometimes thwarted because sowing pasture using conventional means can be expensive and time-consuming at a time of the year when labour is often tight.

"To mitigate these entry barriers, the innovation of twin-sowing, which is a more than promising system, has been developed by Drs Angelo Loi and Brad Nutt of the Department of Agriculture and Food Western Australia," Fiona acknowledged.

Fiona's UWA fourth year honours supervisors were Professor Ross Kingwell (UWA/DAFWA) and Assistant Professor Amin Mugeru (UWA).

THE SIR ERIC SMART SCHOLARSHIP

UWA Institute of Agriculture Director, Winthrop Professor Kadambot Siddique, explains that the late Sir Eric Smart was a pioneer cereal producer in light land areas around Mingenew, near Geraldton WA.

Once the world's largest individual wheat grower, Sir Eric showed his appreciation of science by endowing substantial funds upon his death in 1973 to UWA. This was later supplemented by a gift from his son Peter.

"He wanted science to improve agricultural production and the first allocation from his bequest to UWA was to help lupin growers deal with manganese deficiency," Professor Siddique said.

Sir Eric came to WA in 1934 from South Australia with his life savings of 200 pounds to share farm at Watheroo. In 1949 he acquired 'Erregull Springs', a 10,000 hectare property at Mingenew. More than half the farm was light sand-plain country and it was there that he experimented with superphosphate and lupins to build the soil fertility of the light land for cropping.

GLOBAL SEARCH UNEARTHING PROMISING LEGUMES

Alternative species of perennial pasture legumes from southern Africa could help Australian producers fill traditional green feed gaps in autumn and late spring, the 17th International Congress on Nitrogen Fixation, held in Perth in November 2011, was told.

Perth-based Centre for Rhizobium Studies director Associate Professor Graham O'Hara said the GRDC-supported CRS was currently investigating African herbaceous perennial legumes such as *Lebeckia*, *Lessertia* and *Lotononis* for their suitability in Australian farming systems.

"These species are showing promise in providing green feed for grazing over a longer period than traditional perennial legumes such as lucerne and white clover," he said.

"Many Australian soils do not sustain traditional perennial legumes throughout the year because of stresses such as acidity, low clay content, low nutrient status and low rainfall."

Introducing overseas legumes

Graham said Australian researchers continued to introduce legumes from overseas, in a bid to find species better adapted to local soils.

"But because Australian soils don't naturally contain rhizobia which form effective nitrogen-fixing symbioses with these legumes, inoculation with introduced rhizobia is essential," he said.

Rhizobia are soil bacteria that fix nitrogen into the soil after becoming established inside the root nodules of legumes.

The legume introduction program at CRS is being run by Professor John Howieson as part of an African-based project funded by the Australian Centre for International Agricultural Research (ACIAR).

"During the past 15 years the CRS and the National Rhizobium Program have developed 15 strains of rhizobia for commercial production, and contributed to the development of new legumes which, together with their rhizobia, have been sown over five million hectares in Australia," John said.

"In addition, new insights have been obtained into phenomena affecting the symbiotic relationship between legumes and rhizobia."

The congress was sponsored by the Grains Research and Development Corporation (GRDC), hosted by the Centre for Rhizobium Studies (CRS) at Murdoch University, and supported by Curtin University, the Department of Agriculture and Food (DAFWA) and the Perth Convention Centre.



Professor John Howieson, of the Centre for Rhizobium Studies, collects *Lebeckia* in South Africa.

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Boom times – you'd better believe it

■ By Neil Clark, market analyst, Neil Clark & Associates

THERE is far more money in farming than most people imagine and the big winners in the near future will be farmers themselves, agricultural service providers and their rural communities.

This sunny outlook for agriculture comes after the second year of improved production in Australia's eastern states and remarkable changes in certain key indicators which point strongly to the benefits of a period of exceptional cash flow and industry growth.

We have identified five critical benchmarks which clearly demonstrate that agriculture has made great headway already into a new era of prosperity.

This renewed vigour in agriculture's cash flow is fully expected to boost spending on machinery and new technology, encourage land purchases, top up farmers' bank accounts and stimulate spending in local towns.

The size of the opportunity we have here is far greater than most imagine. Our five identified benchmarks supports this scenario.

Improved farm production

In 2010–11, we saw farm production of \$49.3 billion, with a net value of a massive \$12.7 billion – and the 2011–12 year sees a forecast production figure of \$50 billion.

Two years of healthy farm profits is great news for manufacturers and suppliers of farm inputs and services – but more good news is still to come, with land values tipped to take off and new investment opportunities emerging.



Neil Clark, market analyst, Neil Clark & Associates, Bendigo.

Larger more productive farms

The second indicator lies in the fact that, while farmer numbers are declining, the number of larger producers is rising.

Farm enterprise numbers have, in fact, fallen by 14 per cent in the 10 years to 2010, a loss of 18,800 enterprises," he says.

On the other hand, there are now 6782 high-production farms in Australia with farm incomes greater than \$1 million and their numbers have increased by 74 per cent in the same period.

These large producers generate 48 per cent of total farm production in Australia.

Most rural industries have seen a rise in the numbers of their larger commercial producers.

The most significant industry is grains and cotton with 2182 producers (equal to 32 per cent of total producers in these areas), followed by horticulture with 1586 (23 per cent).

Growth in the beef industry has slowed, but that still took third place with 934 producers (14 per cent).

Increasingly, we are seeing these larger farms employing strong succession programs, so they are run by younger managers who are often more attuned to efficiency and the use of advanced technology linked to optimisation and decision support.

Strong bank lending

The third indicator we have identified is seen in the banks' strong lending to agriculture.

Bank lending to agriculture reached a record \$60 billion at June, 2011. Annual growth in farm lending in the June quarter sat at 2.2 per cent and agriculture and mining are the only two industries showing growth in borrowing.

Farm Management Deposits are strong

FMDs hit a record level at June, 2011, of \$3.2 billion, an increase of 16 per cent over the previous June.

Furthermore, the mixed farming industry (grain, beef and sheep) topped the list at \$771 million, or 24 per cent of the total deposited.

High water storage levels

Our fifth indicative benchmark is that water storage levels are high.

Good rains have fallen in most parts of Australia and soil moisture levels in the eastern states are very healthy. Most dams are full – to an average of 85 per cent in eastern Australia – so irrigation water is guaranteed and water allocations are at 100 per cent in most systems.

All in all, we are looking at a period of renewed prosperity for farmers and rural communities.

These improved conditions will encourage small or retiring farmers to sell and allow others to grow their businesses. For farmers staying on their properties, these conditions bring an incentive to undertake further investment in their land, livestock and environment.

This is a time of new market opportunities – and this is the time to take them up.

Neil Clark & Associates is a Bendigo-based company which has been providing market analysis and insights to Australian businesses for the past 25 years.

For more information: Neil Clark 0418 571 411.

The atmosphere is right for air emissions studies

■ By Ann Perry, Agricultural Research Service – USDA

"AIR doesn't have any boundaries," says Agricultural Research Service (ARS) chemist Laura McConnell. "So when we study the dynamics of different components that affect air quality, we're trying to figure it out in an open system. For instance, maybe the compound we're studying comes from a local source – or maybe it's coming from a 100 miles (160 kilometres) away."

"This kind of research is a real challenge," agrees Charlie Walthall, who is the national program leader for ARS's work on air emissions. "But there is a substantial payoff for farmers and for the public. We are working to develop management practices that increase the efficiency of agricultural production and that also protect and enhance our soil, water, and air."

As part of this effort, Laura is just one of dozens of ARS scientists conducting research in a system where controls are hard to come by. She has teamed up with ARS chemist Cathleen Hapeman, who works with Laura at the ARS Environmental Management and Byproducts Utilization Laboratory in Beltsville, Maryland, to identify factors that affect pesticide levels in the Chesapeake Bay region 'airshed'.

Some of these pesticides, including organochlorine insecticides and their breakdown products, are considered 'legacy' pesticides



Chemists Cathleen Hapeman (left) and Laura McConnell use air and rain sample collection devices to study the fate of atmospheric pollutants in the Chesapeake Bay region. (Photo: Peggy Greb)



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because, even though US farmers are no longer permitted to use them, trace levels of the chemicals can still be detected in the air, soil, and water.

Tracking trace chemicals

Working with partners at the University of Maryland and the University of Delaware, the scientists established three monitoring stations in the Chesapeake Bay Watershed. One was near the Choptank River in Cambridge, Maryland. A second site was located at the University of Delaware in Lewes, and the third was set up at the Delaware National Estuarine Research Reserve in Dover.

From 2000 to 2003, the team obtained weekly air samples and rain samples for each precipitation event from the three sites. Then they tested the samples in the lab for several types of legacy pesticides, including chlordane and related chemical products such as:

- Heptachlor and breakdown products of chlordane;
- Lindane;
- Aldrin and dieldrin;
- DDT and its degradation products (ddd and dde); and,
- Mirex.

All of the pesticides were detected in at least one air sample, but they were rarely detected on particles captured from the air. Nearly all the air samples contained lindane and chlordane products, and the pesticides with the highest mean concentrations were dieldrin and DDE.

Here, there, and everywhere

Results also indicated that some of the legacy pesticides detected in the samples – chlordane compounds, lindane, DDE, and dieldrin – came from local and regional sources, possibly from contaminated soils. When disturbed, the generally sandy soils on the Delmarva Peninsula are more likely to release pesticides than soils with a higher organic carbon content.

But these studies also suggested that most of the lindane, heptachlor, and many of the chlordanes detected in the air samples came from sources more than 60 miles (97 kilometres) away.

Using models, Laura and Cathleen also found that variability in air temperature and wind conditions accounted for 30 to



Soil scientist Lynn McKee filters soil samples for pesticide analysis while technician Alex White uses a rotary evaporator to process pesticide samples. (Photo: Peggy Greb)

60 per cent of the variability of compound levels. And – some good news – with the exception of dieldrin, the half-life values measured for the pesticides in the samples indicated that legacy pesticide levels were decreasing over time in the Delmarva.

“The Chesapeake Bay region is a mix of urban areas and agricultural areas,” says Cathleen. “But water quality in the bay itself is highly influenced by atmospheric chemistry, not just by runoff from urban lands and farm lands. These measurement studies and new modeling efforts with ARS environmental engineer Cody Howard are helping us understand the role that past and present agricultural practices and air quality play in restoring and maintaining water quality in the bay.”

A pesticide's surprising path

A few fields away in Beltsville, ARS soil scientist Timothy Gish and his colleagues are tackling another piece of the air quality quandary – measuring the amounts of pesticides that evaporate into the air after they're applied to the field. ARS micrometeorologist John Prueger, who works at the National Laboratory for Agriculture and the Environment (NLAE) in Ames, Iowa, is co-leading the investigation with Timothy. Other ARS scientists on the study include agronomist Craig Daughtry, hydrologist William Kustas, soil scientist Lynn McKee, and physical scientists Andrew Russ and Joseph Alfieri, who all work with Timothy at the ARS Hydrology and Remote Sensing Laboratory. NLAE director Jerry Hatfield is also a project collaborator.

The scientists looked at the field dynamics of atrazine and metolachlor – two herbicides commonly used in corn production. Both herbicides are known to contaminate surface and ground water, usually through field runoff. Many experts believed the chemicals had a low volatilisation rate – that is, after they were applied to the field, they would not readily evaporate into the atmosphere – and that volatilisation was not a contributing factor in local water contamination.

“A lot of research indicated that atrazine and metolachlor



At a study site in Beltsville, Maryland, ARS researchers measure agricultural herbicides that volatilise into the air after they are applied to the field. Soil scientist Lynn McKee (foreground) works on the pesticide air sampler while micrometeorologist John Prueger (left) adjusts the controls on the manifold and soil scientist Tim Gish downloads micrometeorological data. (Photo: Peggy Greb)

runoff increases during or after heavy precipitation," says Timothy. "But there had never been a side-by-side comparison of pesticide lost from runoff and volatilisation."

So the team set up a 10-year study at the Optimizing Production Inputs for Economic and Environmental Enhancement (OPE3) study area in Beltsville, which was established in 1998 to study major environmental and economic issues facing agriculture. It is equipped with remote-sensing gear and other instrumentation for monitoring local meteorology, soil, plants, and ground water. This allowed the team to carry out its studies on a well-characterised site where only the meteorology – and the soil water content – would vary.

"We studied the same fields with the same soil types, the same crops, the same management practice, and the same herbicide formulations," Timothy says. "But we ended up with different volatilisation losses from year to year."

Vanishing into thin air

The team observed that when air temperatures increased, soil moisture levels had a tremendous impact on how readily atrazine and metolachlor volatilised into the air – a key factor that had not been included in previous models of pesticide volatilisation. When soils were dry and air temperatures increased, there was no increase in herbicide volatilisation, but volatilisation increased significantly when temperatures rose and soils were wet. Most of the volatilisation from wet soils occurred within the first three days after the herbicide was applied.

The link between soil moisture and volatilisation was highlighted in 2003, when it rained at least once every week in May and June, which prevented the team from planting their experimental corn crops until July. Once the corn was in, it rained again for another two weeks. When the skies finally cleared, the scientists were able to apply the herbicides to the soggy fields.

"By this time, the soils were very wet. Five days after we applied the herbicides, we'd lost up to 63 per cent of the metolachlor and 12 per cent of the atrazine through volatilisation," Timothy says. "Losses were 35 to 40 per cent higher in the wetter spots in the field. Generally, four to five per cent losses are a big deal, so we saw a lot of compounds going off into the atmosphere."

The scientists also noted a correlation between subsoil water movement and herbicide volatilisation – a dynamic they could track and document because of the extensive instrumentation at the OPE3 site. As the water rose up through the soil layers and came closer to the surface, volatilisation of atrazine and metolachlor increased.

"Sometimes we've also seen volatilisation occur when we haven't expected it," John adds. "For instance, we've found that when the soil is dry, volatilisation can increase at night because dew formation increases surface soil moisture."

Understanding the volatilisation process

Timothy and colleagues plan to take their results and begin looking in more detail at volatilisation processes. "Do we have the right set of data to predict pesticide loss? What creates a threshold condition for volatilisation? Is it moisture alone, or soil moisture with air temperature and humidity, or atmospheric stability, or what?" Timothy asks. "Before I retire, I'd like to be able to develop a model for pesticide volatilisation that contains all the relevant parameters."

Even though the models need refining, the results have already had a payoff. "Some farmers have become more careful about how they apply herbicides to their fields, because higher volatilisation levels lower efficacy and lower yields. Besides,

they live where they work, and they want to protect the local environment," says John. "But we still need to improve our measurements. When we find more accurate instrumentation or techniques, we can use them to reduce our margin of error in the measurement of pesticide volatilisation."

Calculating the impact of cows

Across the country in Idaho, where the number of dairy cows has increased around 88 per cent in the past 12 years, another group of scientists is collecting data on greenhouse gas emissions from dairy facilities and identifying how those emissions fluctuate daily and throughout the year. Methane, carbon dioxide, and nitrous oxide can all help trap heat in the atmosphere, and the development of particulate matter from ammonia is also a concern.

"We've calculated some of the first on-farm emission rates for western large-scale dairies, along with emissions per cow and per unit of milk production," says ARS soil scientist April Leytem, who in 2008 was presented with the ARS Pacific West Area Early Career Research Scientist Award for her work in phosphorus cycling in the environment. "We're performing these studies on working commercial dairies, not on experimental farms."

April worked on this project with several other scientists at the ARS Northwest Irrigation and Soils Research Laboratory in Kimberly, Idaho, including microbiologist Robert Dungan, agricultural engineer David Bjorneberg, and soil scientist Anita Koehn. For a year, the group monitored the emissions of ammonia, carbon dioxide, methane, and nitrous oxide from a commercial dairy in southern Idaho with 10,000 milk cows. The animals were mostly mature Holsteins that consumed a total mixed ration and produced an average of 34 kg of milk per cow per day. The facility had 20 open-lot pens, two milking parlours, a hospital barn, a maternity

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ARS soil scientist April Leytem and research leader David Bjorneberg use open-path ultraviolet-differential optical absorption spectrometry to determine ammonia concentrations at dairy operations in southern Idaho. (Photo: Peggy Greb)

barn, a manure solids separator, a 10-hectare wastewater storage pond, and a 10-hectare compost yard.

The team set out to calculate the emission rates of the four gases from three areas on the dairy facility – the open lots, the wastewater pond, and the compost yard. After they set up their instrumentation, they collected concentration data continuously

for two to three days each month and recorded air temperature, barometric pressure, wind direction, and wind speed. With this data, they calculated the average daily emissions for each source area for each month.

Their results indicated that, on average, the facility – animals, equipment, buildings, and all – generated 1625 kgs of ammonia, 15,000 kgs of methane, and 186 kgs of nitrous oxide every day. This came to daily emission rates of 136 grams of ammonia, 1400 grams of methane, and 18 grams of nitrous oxide per cow – or 2.3 grams of ammonia, 18 grams of methane, and less than 0.3 grams of nitrous oxide for each pound of milk produced.

Open lots the major source

The team also found that the open lots were the source of the highest levels of ammonia, carbon dioxide, and nitrous oxide emissions. These areas generated 78 per cent of the facility's ammonia, 80 per cent of its carbon dioxide, and 57 per cent of its nitrous oxide. The lots also generated 74 per cent of the facility's methane emissions during the spring.

Generally, emissions of ammonia, carbon dioxide, and nitrous oxide from the open lots were lower during the late evening and early morning, and then increased throughout the day to peak late in the day. These daily fluctuations paralleled patterns in wind speed and air temperature, both of which generally increased during the day – and also with livestock activity, which picked up as the day progressed.

Emissions of ammonia, methane, and carbon dioxide from the wastewater pond and the compost were also lower in the late evening and early morning and increased during the day. Ammonia, methane, and carbon dioxide emissions from the compost peaked during June when the compost was frequently turned and when new manure was being added to the windrows. Methane emissions from the wastewater pond were lowest in April, when seasonally cooler temperatures prevailed, but peaked during October as temperatures rose.

"These studies will help producers meet air quality standards and help regulators determine what the standards should be," says David.

To reach scientists mentioned in this story, contact Ann Perry, USDA-ARS Information Staff, 5601 Sunnyside Ave., Beltsville, MD 20705-5129; E: ann.perry@ars.usda.gov Ph: +1 (301) 504-1628.

DIURON SUSPENDED

The Australian Pesticides and Veterinary Medicines Authority (APVMA) has suspended the use of diuron in high risk situations to protect aquatic ecosystems.

Diuron is used for the control of both broadleaf and grass weeds in agriculture. It is also used to control weeds and algae in and around water bodies. The suspension affects approximately two thirds of the 101 diuron products currently registered.

The suspension addresses a major concern, which is the risk of diuron run-off into waterways. This includes uses that have high application rates or are applied on tropical crops during the wet season.

APVMA Pesticides Program Manager, Dr Raj Bhula, said new information received is being assessed, including monitoring results from Reef Rescue initiatives.

"The APVMA is yet to make a final decision on diuron, but further regulatory action is likely," Dr Bhula said.

The suspension – effective from 28 November 2011 to 31 March 2012 – prohibits diuron use:

- On tropical crops (sugarcane, tea, bananas, pineapples, coffee and paw paw) during the defined no-spray period.
- In irrigation channels, drains, industrial and non-agricultural situations until 31 March 2012.

New use instructions are being issued for the suspension period, including additional restrictions designed to minimise run-off.

Full details about the diuron suspension and review are available at www.apvma.gov.au



Hofherr-Schrantz-Clayton-Shuttleworth

■ By Ian M. Johnston

To most unenlightened non-tractor folk, the above name is probably suggestive of either one of these incomprehensible menu selections with which one is confronted in a typical yuppy Little Collins Street restaurant, or some weird cocktail also available in one of the aforementioned establishments.

But to those of us on a higher intellectual plane, that is, blessed with a knowledge of old tractors, we know of course that the HSCS is in fact the name of a quirky Hungarian tractor.

It is not surprising that with such a mouthful as Hofherr-Schrantz-Clayton-Shuttleworth, the company preferred to be known as HSCS.

HSCS in the beginning

The origins of HSCS extend back to the 19th Century and combined British and Hungarian interests – an unlikely combination at that time.

Nathaniel Clayton was a crusty English sea captain, but also an acknowledged expert in the field of steam engines. In 1842 he

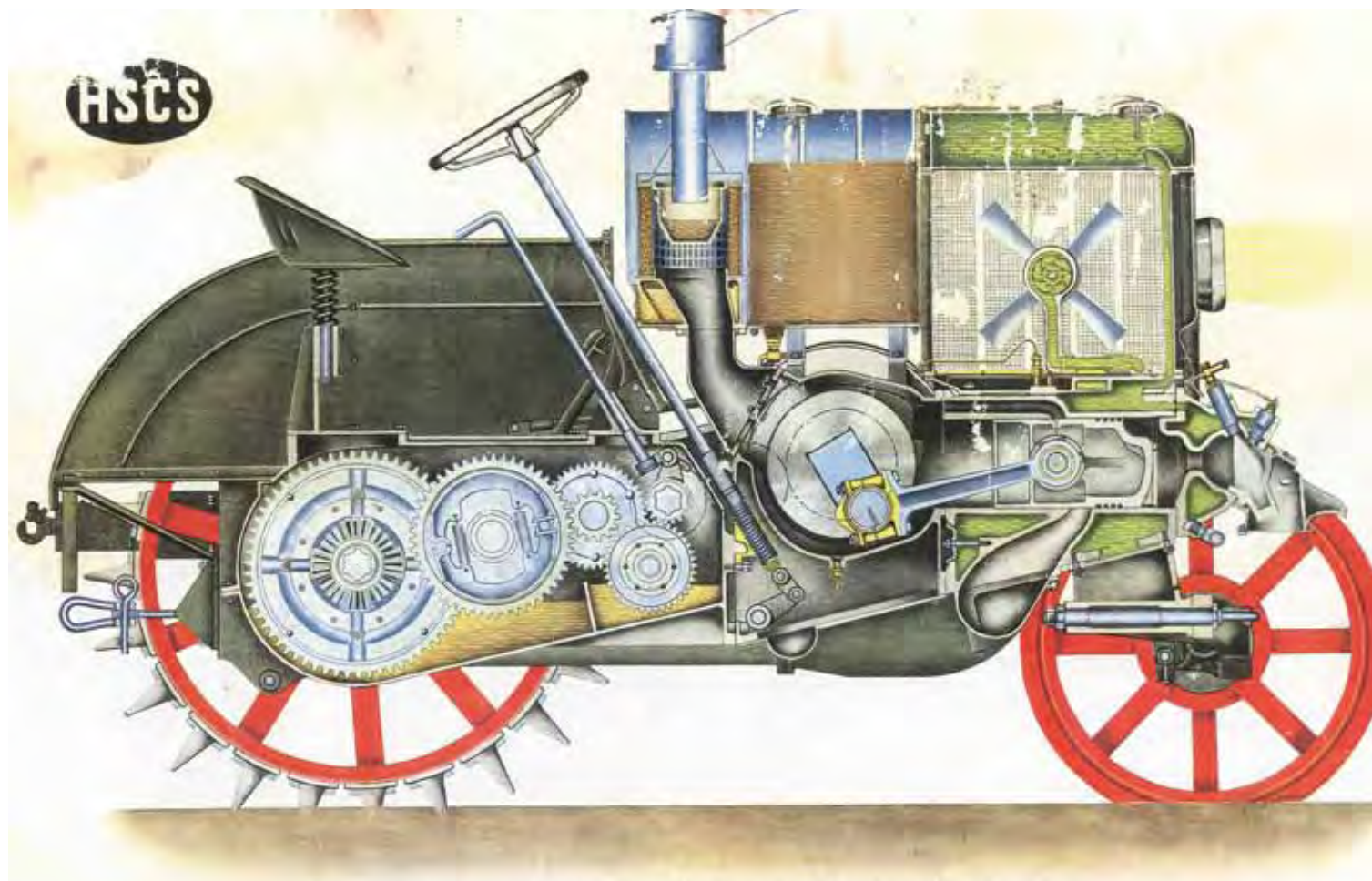
retired from his naval career and formed a business partnership with Joseph Shuttleworth – a respected engineer. They established a firm in Lincolnshire for the purpose of designing and manufacturing marine engines. But in response to the rapid expansion of mechanised farming, the factory switched to the production of agricultural steam engines together with a range of portable threshing machines.

Clayton and Shuttleworth Ltd experienced a dramatic growth of business and became one of the largest and most prestigious steam engine manufacturers of the period and ranked alongside such firms as Heinrich Lanz of Germany, J.I. Case of the US and Marshall and Sons of England.

By the year 1862 Clayton and Shuttleworth were exporting their machines from Lincolnshire to eager markets in Continental Europe as well as Russia, Africa and the Far East.

Budapest

Towards the end of the 19th Century, a group of wealthy Hungarian Magyar noblemen, who jointly owned vast tracts of



Tracteur à roues HSCS à huile lourde, Section longitudinale.

A brilliant cutaway drawing of an early HSCS. (IMJ archives)



A historic 1935 photo of three of five HSCS tractors ploughing at Liebe's farm, Wubin, W.A. (Photo courtesy Tracmach Museum, WA)

Hungarian prairie farm land, had ambitions of establishing a farm machinery manufacturing plant in the nation's capital Budapest.

The principal shareholders in the proposal were Matthias Hofherr and Janos Schrantz, both agricultural engineers of distinction. A decision was taken to approach Clayton and Shuttleworth with an offer for them to purchase an interest in the new Budapest enterprise, thus bringing with them their expertise and engineering skills. The Englishmen enthusiastically embraced the proposal and thus in 1900 the firm of Hofherr-Schrantz-Clayton-Shuttleworth came into being. The first units to bear the brand of HSCS were a range of state-of-the-art threshing machines.

The Hungarian manufacturing facility prospered and diversified. In 1921 the first HSCS tractor was introduced. The German firm of Heinrich Lanz A.G. had offered the services of its chief tractor design engineer Doctor Fritz Huber, to assist with the design of the new tractor. It featured a single cylinder hot bulb type engine, which was ideally suited to farmers with no prior mechanical experience.

The two stroke valveless configuration of the HSCS engine was simple and reliable. Almost any type of combustible fuel could be used, including lamp oil, used cooking fat and old sump oil drained from other vehicles. Starting the engine required the pre-heating of the hot bulb section of the cylinder head with a blow torch, prior to rocking the flywheel in a pendulum motion until

the engine fired into life, generally accompanied by a shattering explosion and a spectacular emission of sparks from the tractor chimney.

HSCS in Australia

In 1934 Western Australia was the first state to receive an importation of HSCS tractors. This consisted of three K50 'Steel Horse' models. In total 80 HSCS units were sold to Western Australia farmers prior to the outbreak of World War 2. Wheat farmers in that state relished the fact that a 'Steel Horse' would consume only 12 gallons of fuel while performing hard work during a full eight hour day.

In 1949 following an absence of 10 years, HSCS tractors (now Hungarian Communist state owned) were re-introduced into Australia by Brown and Dureau Ltd. The most popular of the range, which included crawler tractors, proved to be the G35. In actual fact there were very few technical differences between the 1949 tractors and the original 1921 models. The transmission, brakes, steering and cosmetics had been improved over the years, but the engine remained basically the same single cylinder hot bulb design.

By the mid 1950s, Australian farmers were tending to become weary of the noisy and bone-jarring characteristics of the single



A 1951 HSCS R30/35. An excellent example restored by Hedley Shaw of Tasmania. (Photo IMJ)



A 1952 35 h.p. HSCS G35 in the author's collection awaiting restoration. (Photo IMJ)

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An interesting 1937 25 h.p. HSCS L25 crawler, restored by Ferg Innes and on display at the world famous Booleroo Steam and Traction Preservation Soc, SA. (Photo IMJ)

cylinder design. The smoother running multi-cylinder engines with their push button starts, were certainly more user-friendly and desirable than the single cylinder two stroke designs.

But those farmers who still remained dedicated to that reliable and simplistic concept, found that the Lanz Bulldog company had modernised their single cylinder tractors to the extent that they were now eminently more sophisticated than the HSCS machines. Accordingly, Lanz sales in Australia remained healthy, while HSCS tractor sales fell away until the tractor was quietly removed from the market during the mid 1950s.



HSCS was renamed Dutra by the Hungarian Communist Party. This 1969 Dutra DK4B is powered by a 125 h.p. Csepel (Hungarian built Austrian Steyr) 8 litre 6 cylinder diesel engine. It was imported into New Zealand in 1969 by Drummond Industries and is now owned by Bill and Stuart Sanders of Ohoka, New Zealand. (Photo IMJ)

Interestingly, in 1955 the Hofherr-Schrantz-Clayton-Shuttleworth company was renamed Dutra. It appears the Communist State was anxious to obliterate all references to a capitalist past. The factory switched its production priority to that of heavy dumpers and also trucks. In 1961 a range of heavy duty four wheel drive Dutra tractors was introduced, and were among the earliest true heavyweight tractors of the post war era.

During the 1970s Dutra amalgamated with another state owned firm named Raga and a licensing arrangement was entered into with the Steiger Tractor Company of Fargo, North Dakota. The Budapest company was renamed Raga Steiger and produced a range of Steiger tractors largely for the East European market.

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IAN'S MYSTERY TRACTOR QUIZ

Question: This is the view from the driver's seat of which tractor?

Clue: If ever there was a tractor lemon – this is it!

Degree of difficulty: Easy for collectors of masochistic tractors.

Answer: See page 48.





Managing wet summer fallows in the northern grains region

■ An interview with Ian Taylor, Steve Walker, Vikki Osten, David Thornby and Jeff Werth

WEATHER forecasts for the northern grains region this summer are for wetter than average conditions – to date forecasts have been on the mark with record rainfalls being received across much of the northern grains region. These wetter than average conditions can provide significant upsides for farm businesses that achieve high fallow efficiencies – in terms of double cropping or consecutive summer cropping opportunities – enabling growers to maximise income potential.

But the wetter than average conditions also present challenges for growers, as warm moist conditions provide an ideal growing environment for summer weeds and multiple rainfall events result in numerous flushes of many weed species.

These conditions make it difficult for growers to get on to their fields and therefore weeds can quickly get out of hand.

Further, limited opportunities to apply herbicides mean growers and contractors need to cover large areas in a short period of time and balance the priorities of managing weeds in crop, versus those in fallow. This could tempt applicators to increase spray speeds reducing the effectiveness of herbicide applications and potentially increasing the risk of herbicide drift.

AT A GLANCE

Weed management in summer fallows during wet years can be extremely challenging with opportunities for good weed control being limited:

- Growers should maximise the effectiveness of weed control options at every opportunity to minimise the addition of weed seed to the soil seed bank.
- Double knock strategies including incorporation of a residual herbicide can be particularly effective for controlling weeds and significantly reducing seed production.
- Growers should use robust herbicide rates and pay particular attention to setup and operation of spray rigs to maximise effectiveness and minimise drift potential.
- Wet years can exacerbate resistant weeds. Growers should be aware of their risks and implement management plans accordingly.
- Growers may consider the inclusion of short season crops or cover crops so as to use different MOA herbicides and crop competition for weed management.

A few survivors can cause major problems

Associate Professor Steve Walker from Queensland Alliance for Agriculture and Food Innovation (QAAFI) at The University of Queensland says: "The successful management of weeds in summer fallows is critical because a few survivors can produce large amounts of seeds, which will then be the source of a major problem next year.

"Each fleabane plant can produce up to 100,000 seeds, and each barnyard grass plant can produce up to 40,000 seeds. So each surviving fleabane and barnyard grass could result in many thousands of seedlings emerging in the next season, particularly if it is wet again."

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Weeds grow rapidly in wet summers and can set large seed numbers.

Double knock works

Jeff Werth a senior weed scientist with the Queensland Department of Employment Economic Development and Innovation (DEEDI) adds that: "Growers should aim to maximise the effectiveness of their applications in fallow during wet years. As weeds grow rapidly and have the potential to set large numbers of seed it is important to get on top of weed issues at every opportunity.

"Double knock strategies are particularly effective for controlling weeds and significantly reducing seed production and subsequent addition to the seed bank. Incorporation of a residual herbicide with the double knock can also minimise subsequent emergences. For example, applying glyphosate mixed with a herbicide like Flame, followed 4 to 7 days later by a Gramaxone/ Spray.Seed or Alliance (amitrole plus paraquat) will control most weeds present as well as suppressing or preventing the germination of weeds following the next rain event."

But the persistence (or the effectiveness) of residual herbicides will depend on the amount and intensity of rainfall. In wet years this persistence will be shorter than drier years.

"It is important to note that with frequent rainfall, it can be harder to get equipment into the field due to wet ground," Jeffs says. "So it is critical that the herbicides are always applied correctly and at robust herbicide and water rates to maximise the effectiveness of each application. The penalties for poor



A big challenge for successful weed management in summer fallows is the limited number of registered herbicides.

application and poor control will be considerably greater in wet summers.

"Growers may also consider the use of aerial spraying for the glyphosate application as this allows them to cover a large area quickly, then follow up with Gramoxone plus Flame – or once the field is sufficiently dry to enable ground rigs to operate without causing significant structural damage.

"Growers need to be mindful of the potential for herbicide drift and proximity of glyphosate-sensitive crops and native vegetation if using this strategy," cautions Jeff.

One of the key challenges of successfully managing weeds in summer fallows is the limited number of herbicides registered for fallow control.

Many residual herbicides and particularly those with efficacy against grasses such as pendimethalin, trifluralin and metolachlor are not registered for use in fallow. This means growers become dependent upon knock down herbicides such as glyphosate and paraquat.

"Farming systems have changed greatly over the past 10 to 15 years. But for a number of reasons, label registrations have not kept pace with this evolution and this restricts the available options for growers," says Jeff.

Rate, application speed and height

Vikki Osten, Principal Weed Scientist with DEEDI based in Emerald, has a lot of experience managing weeds in wet summers. Vikki recommends that "growers use robust rates when applying herbicides and pay particular attention to boom heights and application speeds to maximise the effectiveness of herbicide applications.

"As well, growers should use a coarse droplet spectrum to minimise drift potential and continually monitor conditions during spray operations as these can change rapidly during unstable weather periods, particularly as frontal systems pass through areas."

Glyphosate resistance

In recent years, farmers in the northern grains region have been challenged by the development of glyphosate resistance in a number of key weed species including flaxleaf fleabane, awnless barnyard grass, windmill grass and liverseed grass. Other species such as feather top Rhodes grass – which are more tolerant of glyphosate – are beginning to dominate the weed spectrum in a number of fields.

"In wet years population explosions greatly increase the chance that a rare individual with a gene conferring resistance could be present in the field," Steve Walker points out. "And where resistant individuals are present in a field, wet years can greatly increase those numbers. Growers should focus on 100 per cent control to prevent these rare individuals producing large amounts of seeds and thereby greatly increasing the resistance problem."

"Growers in the north should have a well-developed integrated weed management plan with strategies to mitigate potential resistance risks," he says.

These strategies can include tactics such as rotating herbicide modes of action or even better incorporating double knocks to ensure that there are no weed escapes. Monitoring sprayed paddocks closely is critical to ensure survivors are controlled in a timely manner.

Strategic cultivation

In years where there is plentiful moisture, growers may also consider incorporating tillage to manage weeds in fallow. The strategic use of cultivation prior to weeds setting seed can help



Strategic cultivation should not be considered a 'dirty word' particularly when considering resistance management strategies.

growers manage resistant weeds, and further delay the onset of resistance where resistant weeds are not evident.

Growers can use long-range rainfall forecasts on the Bureau of Meteorology website to assist in the planning of spraying operations or identify cultivation opportunities.

Glyphosate and zero till practices have become the cornerstone of dryland farming systems in the north and these have contributed to both an improvement in yield and the reliability of yields over the past decade. Nonetheless, cultivation should not be seen as a 'dirty word'. When used strategically, cultivation can in fact greatly contribute to the sustainability of these farming systems.

Risk and RAT

To enable growers to assess their glyphosate resistance risks, DEEDI scientists David Thornby and Jeff Werth have developed the online glyphosate resistance assessment tool affectionately known as 'the RAT' (see http://www.dpi.qld.gov.au/26_16653.htm or search for "Online Glyphosate Resistance Toolkit").

"The risk assessment tool takes into consideration the biological and ecological characteristics of weeds present in a field and weed management practices used to control them," explains David. "This allows the RAT to develop a risk profile for the field. The tool gives the grower a snapshot of which weeds are most at risk of resistance, and which crops and fallows are being managed at high and low risk."

"Growers can use the tool to identify which weed species they should be driving their resistance prevention plans around, and where in their rotation they would get the best results out of making changes in their weed management," says David.

Alternative crops

Vikki also suggests that "growers investigate the opportunity to use short season crops or cover crops as an alternative to fallow, when circumstance allow, so different mode of action (MOA) herbicides can be used while using crop competition for additional weed management."

"For example, planting soybeans or mungbeans in December or January will enable growers to use herbicides such as trifluralin (Group D), Blazer (Group G) and Targa (Group A) for control of a range of grass and broadleaf weeds as well as providing crop competition which may not normally be used in a rotation."

"Growers should aim for full weed control to prevent large additions of seed to the soil seedbank," Vikki says.

Work reported in this article is supported by the Grains Research and Development Corporation

Stored grain pests go with the gene flow

NEW Australian research aims to uncover more information about the ecology of two major insect pests of stored grain, in a bid to finetune management strategies and minimise the development of resistance to fumigants. The Department of Agriculture and Food WA (DAFWA) and bulk handler the CBH Group are collaborating in the research which will help ensure Australian cereal grain continues to meet market requirements, including nil tolerance to live insects in export grain.

The study is part of a bigger insect ecology project within the Cooperative Research Centre for National Plant Biosecurity (CRCNPB), of which the Grains Research and Development Corporation (GRDC) is a partner.

Led by Greg Daglish of the Queensland Department of Employment, Economic Development and Innovation (DEEDI), it involves research in the GRDC's northern, southern and western regions. Gimme Walter from The University of Queensland is providing ecological expertise and access to population genetics skills and resources.

The insect 'ecology' being studied under the project refers to the broad biological issues associated with the pests – including emigration, immigration, reproduction rates and timing of flight and other issues.

The WA component of this project is studying the insect



Grain insect ecology traps help to establish how distinct strains of pests are distributed.



DAFWA senior entomologist Rob Emery.

ecology of two beetle species – the lesser grain borer (LGB) (*Rhyzopertha dominica*) and the rust red flour beetle (RFB) (*Tribolium castaneum*).

Both these insects are impediments to market access and are capable of developing resistance to phosphine, commonly used for insect control.

Insect gene flow

In the study, the researchers are looking at 'gene flow', which refers to the way in which distinct strains of the insects (which could include phosphine-resistant strains) spread, and where they go. The WA insect ecology study follows research into these two species carried out in Queensland – conducted by DEEDI, GrainCorp Ltd and growers – which found considerable gene flow between the insects occurred at the district level at least (10 to 100 km), and that dispersal through flight contributed to this.

DAFWA senior entomologist Rob Emery, who is leading the WA insect ecology project with Ern Kostas, of the CBH Group, said the WA study provided an opportunity to investigate gene flow on a greater geographical scale.

"Patterns of flight activity are likely to differ between the western and northern GRDC regions because of obvious climatic differences, and so region-specific research is beneficial," he said.

Traps baited with species-specific pheromone lures are being used to monitor flight activity at 12 sites at CBH storage facilities throughout the WA grainbelt.

Rob said it was important to investigate gene flow in the species to help determine how closely related different insect populations were, and therefore whether resistance was spreading between sites, or developing independently.

"Unlike the eastern states where phosphine resistance is more widespread, strong resistance has only been found in five WA locations in the past five years, including three sites closely located on farms near Beacon," he said.

"So far it is unknown whether the three strongly resistant populations near Beacon have developed independently – due to similar management practices – or from movement of resistant insects between the farms.

"The insect ecology project will provide us with more information about how resistance develops and spreads."

Rob said the research would also reveal whether resistant populations of insects could spread from a farm to bushland, and then reinfest other farms.

"Under the insect ecology project, we placed an extra trap in bushland at Boyagin in WA's Upper Great Southern Region, and were surprised to find many LGB and RFB caught in the traps – more than we captured at the nearest CBH storage facility located a number of kilometres away,"

"The bush trap was also more than three kilometres away from the nearest farm.

"It would be interesting to find out if the insects are being lured over some distance to the traps, or if these pests are widely dispersed across the landscape.

"If the insects prove to be very mobile and capable of surviving in bushland and reinfesting grain on nearby properties, this threatens the grain industry's ability to maintain a 'clean pipeline' of insect-free grain."

Rob said researchers had replaced the bush trap with a new 'sticky' trap which he hoped would reveal the direction from which the insects were travelling.

"If the insects are found to be travelling randomly from all directions, this will support the theory that the insects are everywhere and more mobile than previously thought," he said.

Rob said he hoped the results of the insect ecology study in WA would assist fumigation practices, including timing of applications.

"Information about insect movements and behaviour, generated through the trapping work, could help us conduct better timed fumigation of stored grain and avoid unnecessary fumigations which increase the risk of resistance developing," he said.

Initial results from WA

Although the ecology trapping work has been underway in WA for a relatively short time, some initial results are available.

Traps from all 12 sites being monitored in WA trapped nil or very few LGB and RFB over the cooler months of winter and early spring, 2011.

This is a different outcome compared with results from the Queensland study, where the insects were trapped year-round, even during these cooler months.

But Rob is not surprised by the different outcomes for the two regions, given the cooler conditions experienced in winter in WA compared with Queensland.

The numbers of RFB in particular caught in the WA traps increased from late September, with some centres recording quite significant spikes in numbers.

"The catch of RFB increased from about 0 to 5 insects per trap over winter to 20–50 per trap in late spring, with one catch yielding well over 1000 insects," Rob said.

Results in the eastern states

Insect ecology studies in the eastern states have been underway longer than the WA research, and have generated more results.

Rob said pheromone trapping in southern Queensland and southern New South Wales under an initial phase of the research, yielded more than 75,000 LGB and RFB in 2008 and 2009.

The trapping revealed considerable flight activity during all but the coldest months.

RFB was more likely to be trapped near silos, while LGB was trapped more widely including in native vegetation reserves.

"Population genetics tools were used on the trapped beetles to confirm that there is considerable gene flow in these species on a scale of 10 to 100 kilometres, and that active dispersal must contribute to this," Rob said.

"Samples of LGB have recently been screened for a gene contributing to strong phosphine resistance.

"The frequency of this resistance allele in populations of trapped beetles was not significantly different between samples trapped at farm silos and in paddocks at least one kilometre from the nearest stored grain, once again indicating gene flow."

Adults emigrating from infested farm silos were long lived, and most females had mated before emigrating, and were capable of reproduction for many weeks without further mating.

Rob said that under a second phase of the insect ecology project in the eastern states, traps had been placed along a 30 km transect running south from Emerald in central Queensland.

"Trapping is revealing two major trends – the first is that RFB are much more likely to be trapped near depots while LGB is being trapped more widely across the landscape transect," he said.

"This supports the findings from the initial phase of the project which investigated flight activity in a farming landscape in southern Queensland.

"The second trend from the latest trapping work is strong synchronicity of mean RFB and LGB numbers over time, indicating similar responses to weather or other variables."

Conclusions from the second phase of the insect ecology research include:

- RFB and LGB are capable of dispersing by flight away from stored grain although the spatial scale appears to differ for the two species, and this is contributing to gene flow on a scale of 10 to 100 km;
- Seasonal flight activity shows that infestation pressure from flying beetles is present year-round in central Queensland, while in WA flights occur in the warmer months;
- RFB is more likely to be trapped near bulk stored grain, suggesting that this species does not exist in significant numbers outside of bulk storage;
- LGB is being trapped more widely but whether this reflects greater capacity for dispersal by flight or other factors needs to be ascertained; and,
- Findings have overturned assumptions regarding active dispersal in these pests and have implications for the scale at which pest and resistance management must be exercised. ■



A grain insect ecology trap in a bush block located a few kilometres from stored grain.

Back pocket guide helps prevent pest pitfalls

GROWERS inspecting grain storage facilities can carry with them a useful new resource to help identify any pests which may be present.

The Grains Research and Development Corporation (GRDC) *Stored grain pests identification Back Pocket Guide* provides a snapshot of common pests found in stored grain in Australia.

As well as images and descriptions of common pests, the guide contains information about how to monitor and identify grain pests; control measures; and how to send samples for testing so that insects can be checked for resistance.

There is nil-tolerance for live storage pests in grain sold off-farm for the domestic, human-consumption, or export markets.

Growers need to identify pests early and conduct monitoring monthly, at the very least.

The GRDC *Stored grain pests identification Back Pocket Guide* was mailed to growers in the November/December edition of GRDC's *Ground Cover*.

It can be downloaded from the GRDC website at www.grdc.com.au/GRDC-BPG-StoredGrainPests, or growers can visit the stored grain information hub at www.storedgrain.com.au ■



The Lesser Grain Borer is a serious pest of most stored grains. It has developed resistance to a number of insecticides.

Tips on pre-harvest management of staygreen sorghums

■ By Ivan Calvert, Pioneer Hi-Bred Australia

THE end of this summer growing season will be here before we know it, so it's timely to be thinking about pre-harvest management, especially with grain sorghum hybrids, such as Pioneer hybrids G56 and G99, that have higher levels of staygreen.

We have added these hybrids to our G series product range because they provide:

- Increased resistance to diseases such as charcoal rot and fusarium stalk rot;
- Increased resistance to lodging due to drought stress;
- Healthier crops for longer in the season to help fill grain even during periods of late season moisture stress; and,
- Higher yield and larger grain size in drought-affected crops.

The most important point is that hybrids with higher levels of staygreen need to be as close as possible to full black layer before spraying out with glyphosate.

Because staygreen hybrids will be healthier and greener at the end of the season, pre-harvest spray-out can be delayed until the crop is mature because there is little to no risk of lodging.

In some cases spraying too early has induced lodging, small grain and low test weight in staygreen and traditional senescent type hybrids.

Last season the Pioneer research team ran a trial to determine best management practices for pre-harvest spray-out of grain sorghum hybrids with higher levels of staygreen.

In the trial, four hybrids with varying levels of staygreen were

planted over four planting dates (day 1, day 6, day 13 and day 17). When all the hybrids on the earliest planting date (day 1) had reached 100 per cent black layer (physiological maturity) and had grain moisture levels less than 20 per cent, the entire trial was sprayed with Roundup and ammonium sulphate.

This meant that many of the hybrids on the later plantings (days 6, 13 and 17) were sprayed out well before reaching black layer (Table 1)

TABLE 1: Percentage of black layer of the four grain sorghum hybrids when all treatments were sprayed out.

Hybrid	% black layer			
	Planting day 1	Planting day 6	Planting day 13	Planting day 17
86G56 – high staygreen	100	95	85	60
84G99 – mod/high staygreen	100	95	85	65
84G22 – low/mod staygreen	100	100	90	70
MR Buster – low staygreen	100	100	90	70

The main trial results (Table 2)

- Irrespective of the level of staygreen, spray-out at 100 per cent black layer and below 20 per cent grain moisture resulted in all hybrids achieving acceptable grain moisture levels eight days after spraying.
- The effects of the premature spray-out on the hybrids from planting days 6 and 13 of the staygreen hybrids can be seen in higher grain moisture compared to the lower staygreen hybrids. This could result in increased time to harvest.
- When all hybrids were sprayed for the day 17 planting time, the grain moisture was the highest of all planting times and there was little difference between hybrids.
- Day 1 and 6 planted hybrids showed no signs of lodging. Day 13 and 17 planted hybrids showed some signs of lodging.

TABLE 2: Grain moisture percentage eight days after spray-out

Hybrid	Moisture %			
	Planting day 1	Planting day 6	Planting day 13	Planting day 17
86G56 – high staygreen	14.9	16.2	17.6	18.8
84G99 – mod/high staygreen	14.3	15.2	16.8	18.6
84G22 – low/mod staygreen	13.2	14.3	14.4	15.5
MR Buster – low staygreen	13.1	13.5	16.2	17.1



Pioneer hybrid G99 (right) in a side-by-side comparison with a non-staygreen competitor hybrid towards the end of the 2009–10 season. Note the far better plant health and much less lodging with G99.

Deciding the best time for pre-harvest spray-out

- Do not judge maturity by grain colour. Some hybrids (eg G56 and G99) change colour early in the grain-filling process which can lead to a false indication of the stage of maturity.
- Black layer should be determined by assessing seed from the very bottom of the head. In later-planted crops, check the seed on the bottom of the southern side of the head.
- Use grain moisture as an indication of maturity. If moisture is less than 20 per cent, spraying with glyphosate at label rates will kill the crop effectively and will allow harvest to begin 10–14 days later.

WITHSTOOD CQ DELUGE

The effectiveness of staygreen was demonstrated with a crop of G56 near Gindie in Central Queensland in the 2010 season.

The crop was planted in mid-February and should have been harvested in July. But the bulk of the Pioneer hybrid G56 could not be harvested until late October because of wet weather and in the meantime, withstood around 250 mm of rain. The grower, Garry Bullivant, said there was no lodging and very little of the grain had sprouted or had been lost from the seed heads. The crop yielded around 2.5 tonnes per hectare.



The crop of Pioneer hybrid G56 in early October 2010, four months after it should have been harvested, and still standing well.



There was very little spouting or grain loss despite the crop withstanding around 250 mm of rain after maturity.

Sequence crops carefully

A LEADING plant pathologist warns grain growers should sequence their crops carefully to limit the impact of plant diseases emerging due to the increased use of pulses and summer crops in rotations. Dr Malcolm Ryley, Agri-Science Queensland principal plant pathologist says summer crops grown in the northern region can harbour fungal diseases that can severely reduce yields in follow-up winter crops.

GRDC-supported research shows one of the most concerning disease links exists between sorghum and head blight of winter cereals, caused mainly by *Fusarium graminearum*.

"Past and recent findings suggest sorghum can play an as yet undefined role in the survival of *Fusarium graminearum*, so sorghum crops should not be planted into or near winter cereal stubble likely to be infected with the pathogen," Malcolm said.

Maize is also a host of *F. graminearum*, particularly on the Liverpool Plains and Malcolm says growers should avoid crop sequences which will put both maize and winter cereals at risk.

Malcolm said growers can also minimise the impact of the main pathogens responsible for sorghum stalk rot, *Macrophomina phaseolina* the cause of charcoal rot, and the *Fusarium* species, *Fusarium thapsinum* and *Fusarium andihazi*, through crop sequencing.

"Because of their ability to survive from season to season in infected stubble, the levels of the charcoal rot and fusarium stalk rot pathogens in a paddock will generally increase with consecutive sorghum crops.

"Where charcoal rot has been a problem, other susceptible crops like sunflower, dryland soybean and mungbean should be avoided in future crop sequences for at least three years to reduce charcoal rot levels, and serious consideration should be given to growing a series of winter crops in the crop sequence."

Both *Fusarium thapsinum* and *Fusarium andihazi* have a narrow host range, so if the disease becomes an issue in a paddock, growing a sequence of non-hosts like winter cereals and broadleaf crops will reduce their impact on future sorghum crops.

Sclerotinia also endemic

Several *Sclerotinia* species are endemic in the northern region and can cause significant losses on both summer and winter broadleaf crops.

"These species can survive for many years as hard black sclerotia, so when *Sclerotinia* reaches yield-limiting levels in a paddock, the only rotation options are to change to sorghum, maize and the winter cereals," Malcolm said.

The experiences with plant diseases in the northern region over the past year shows when favourable conditions occur, some pathogens can be found well outside their usual range.

"For example, while *F. graminearum* outbreaks on winter cereals are confined to cooler, wetter cropping areas like the Liverpool Plains in most years, it was found at significant levels in crops in southern Queensland during the 2010 winter growing season," Malcolm said.

"Particular care in sequencing needs to be taken when there has been a significant outbreak of a disease in the previous crop.

"The first step in minimising the impact of the disease on future crops is to obtain an accurate diagnosis on its cause.

"In addition, knowledge of the host range of the causal pathogens and of the key aspects of their biology is vital when planning crop sequences in a particular paddock.

Heavy fleabane pressure ahead

WITH late 2011 winter season rain across New South Wales and much of Queensland for the second year running, the weed fleabane is likely to cause significant problems for grain growers – including those in regions where it's never been seen before.

The warning comes from Maurie Street, Chief Executive Officer of the Grain Orana Alliance (GOA), which is funded by the Grains Research and Development Corporation (GRDC) and runs trials around the NSW central west.

"Fleabane has been an issue in this region for years, but it spread into uncharted territory last year in the south of the state, making a pretty bold appearance in areas as far south as the Riverina," Maurie said.

"The conditions over summer 2010–11 generated huge seed production and the rain we've had recently will be germinating yet more of the weed.

"It's absolutely vital that growers are vigilant. Once the winter crop is off, fleabane needs to be targeted in the first fallow spray or it will be a thorn in the side right across summer.

"Controlling this weed when it is young and fresh is relatively easy and successful – once older it becomes increasingly difficult to control," Maurie said.

Fleabane is now recognised as one of the major difficult-to-control weeds in northern New South Wales and southern Queensland, especially in no-till operations, and some populations have been found to be resistant to glyphosate.

It's one of the priorities for the trials run by GOA, which is once again this summer testing different combinations and timings of herbicides in order to develop systems that can control the weed. ■



**Maurie Street,
Chief Executive
Officer of the GRDC-
funded Grain Orana
Alliance.**

Use glyphosate wisely

WITH northern region cropping operations in the all-important summer fallow weed control period, an urgent appeal has gone out for growers to use glyphosate wisely. James Clark, Grains Research and Development Corporation (GRDC) northern panel chair says glyphosate resistance is shaping as the single biggest threat to Australia's sustainable farming system.

James says growers could face production falls of 20 per cent if glyphosate resistance reaches a level where tillage becomes a regular part of the farming system once more.

"GRDC has funded a major new five-year research project on integrated weed management (IWM) for northern region weeds to follow-on from the current projects on herbicide resistance, fleabane control and delivering applied solutions in central Queensland," James said.

"The new IWM project will have key researchers based in Toowoomba and Tamworth who are responsible for delivering IWM outcomes across the whole northern region."

Current research shows moisture stress and glyphosate resistance are the two big issues in the fight against barnyard grass.

Dr Steve Walker, Department of Employment, Economic Development and Innovation (DEEDI) weed researcher says spray failures in summer fallows are often a result of plant moisture stress at the time of herbicide application.

"This can be confounded by the presence of glyphosate resistance," he said. "Fortunately, last summer was rather wet, limiting the number of glyphosate applications to stressed weeds. This would have been an ideal time to inspect for potential glyphosate resistant barnyard grass as moisture stress was unlikely."

Steve says there is still some belief in the industry that glyphosate resistance in barnyard grass is essentially poor control due to moisture stress and not due to selection pressure of a specific plant type. "Moisture stress will lead to unsatisfactory control, but poor control is also caused by glyphosate resistant populations," he said.

Complex combination

A glasshouse-based experiment examined if an interaction exists between moisture stress, glyphosate resistance status and herbicide rate.

It showed survival is a complex combination of factors including resistance status, herbicide rate and moisture stress.

Steve says growers must ensure herbicide applications are applied to actively growing barnyard grass plants. "This is best achieved by controlling plants within a seven to 14 day period after good rain. Plants are likely to be small, less likely to be stressed and can also be controlled with Group L herbicides."

He said growers needed to undertake resistance testing to confirm the presence or absence of glyphosate resistance.

An excellent time to monitor for glyphosate resistance is after plants have been treated with glyphosate under ideal conditions as this is a time when a large majority of susceptible plants will die and any resistant individuals are more obvious, he said. ■



**Northern panel
chair, James Clark**



Fleabane is likely to cause significant problems for grain growers if not controlled early.

SOUTHERN AUSTRALIA FOCUS

COVERING CROPPING SYSTEMS OF SOUTHERN NSW, VICTORIA, TASMANIA, SOUTH AUSTRALIA & WESTERN AUSTRALIA

THE RESEARCH VIEW

Stored grain pests go with the gene flow

NEW Australian research aims to uncover more information about the ecology of two major insect pests of stored grain, in a bid to finetune management strategies and minimise the development of resistance to fumigants. The Department of Agriculture and Food WA (DAFWA) and bulk handler the CBH Group are collaborating in the research which will help ensure Australian cereal grain continues to meet market requirements, including nil tolerance to live insects in export grain.

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The insect 'ecology' being studied under the project refers to



Grain insect ecology traps help to establish how distinct strains of pests are distributed.

Consultants' Corner

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DAFWA senior entomologist Rob Emery.

the broad biological issues associated with the pests – including emigration, immigration, reproduction rates and timing of flight and other issues.

The WA component of this project is studying the insect ecology of two beetle species – the lesser grain borer (LGB) (*Rhyzopertha dominica*) and the rust red flour beetle (RFB) (*Tribolium castaneum*).

Both these insects are impediments to market access and are capable of developing resistance to phosphine, commonly used for insect control.

Insect gene flow

In the study, the researchers are looking at ‘gene flow’, which refers to the way in which distinct strains of the insects (which could include phosphine-resistant strains) spread, and where they go. The WA insect ecology study follows research into these two species carried out in Queensland – conducted by DEEDI, GrainCorp Ltd and growers – which found considerable gene flow between the insects occurred at the district level at least (10 to 100 km), and that dispersal through flight contributed to this.

DAFWA senior entomologist Rob Emery, who is leading the WA insect ecology project with Ern Kostas, of the CBH Group, said the WA study provided an opportunity to investigate gene flow on a greater geographical scale.

“Patterns of flight activity are likely to differ between the western and northern GRDC regions because of obvious climatic differences, and so region-specific research is beneficial,” he said.

Traps baited with species-specific pheromone lures are being used to monitor flight activity at 12 sites at CBH storage facilities throughout the WA grainbelt.

Rob said it was important to investigate gene flow in the species to help determine how closely related different insect populations were, and therefore whether resistance was spreading between sites, or developing independently.

“Unlike the eastern states where phosphine resistance is more widespread, strong resistance has only been found in five WA locations in the past five years, including three sites closely located on farms near Beacon,” he said.

“So far it is unknown whether the three strongly resistant populations near Beacon have developed independently – due to similar management practices – or from movement of resistant insects between the farms.

“The insect ecology project will provide us with more information about how resistance develops and spreads.”

Rob said the research would also reveal whether resistant

populations of insects could spread from a farm to bushland, and then reinfest other farms.

“Under the insect ecology project, we placed an extra trap in bushland at Boyagin in WA’s Upper Great Southern Region, and were surprised to find many LGB and RFB caught in the traps – more than we captured at the nearest CBH storage facility located a number of kilometres away,”

“The bush trap was also more than three kilometres away from the nearest farm.

“It would be interesting to find out if the insects are being lured over some distance to the traps, or if these pests are widely dispersed across the landscape.

“If the insects prove to be very mobile and capable of surviving in bushland and reinfesting grain on nearby properties, this threatens the grain industry’s ability to maintain a ‘clean pipeline’ of insect-free grain.”

Rob said researchers had replaced the bush trap with a new ‘sticky’ trap which he hoped would reveal the direction from which the insects were travelling.

“If the insects are found to be travelling randomly from all directions, this will support the theory that the insects are everywhere and more mobile than previously thought,” he said.

Rob said he hoped the results of the insect ecology study in WA would assist fumigation practices, including timing of applications.

“Information about insect movements and behaviour, generated through the trapping work, could help us conduct better timed fumigation of stored grain and avoid unnecessary fumigations which increase the risk of resistance developing,” he said.

Initial results from WA

Although the ecology trapping work has been underway in WA for a relatively short time, some initial results are available.

Traps from all 12 sites being monitored in WA trapped nil or very few LGB and RFB over the cooler months of winter and early spring, 2011.

This is a different outcome compared with results from the Queensland study, where the insects were trapped year-round, even during these cooler months.

But Rob is not surprised by the different outcomes for the two



A grain insect ecology trap in a bush block located a few kilometres from stored grain.

regions, given the cooler conditions experienced in winter in WA compared with Queensland.

The numbers of RFB in particular caught in the WA traps increased from late September, with some centres recording quite significant spikes in numbers.

"The catch of RFB increased from about 0 to 5 insects per trap over winter to 20–50 per trap in late spring, with one catch yielding well over 1000 insects," Rob said.

Results in the eastern states

Insect ecology studies in the eastern states have been underway longer than the WA research, and have generated more results.

Rob said pheromone trapping in southern Queensland and southern New South Wales under an initial phase of the research, yielded more than 75,000 LGB and RFB in 2008 and 2009.

The trapping revealed considerable flight activity during all but the coldest months.

RFB was more likely to be trapped near silos, while LGB was trapped more widely including in native vegetation reserves.

"Population genetics tools were used on the trapped beetles to confirm that there is considerable gene flow in these species on a scale of 10 to 100 kilometres, and that active dispersal must contribute to this," Rob said.

"Samples of LGB have recently been screened for a gene contributing to strong phosphine resistance.

"The frequency of this resistance allele in populations of trapped beetles was not significantly different between samples trapped at farm silos and in paddocks at least one kilometre from the nearest stored grain, once again indicating gene flow."

Adults emigrating from infested farm silos were long lived, and most females had mated before emigrating, and were capable of reproduction for many weeks without further mating.

Rob said that under a second phase of the insect ecology project in the eastern states, traps had been placed along a 30 km transect running south from Emerald in central Queensland.

"Trapping is revealing two major trends – the first is that RFB are much more likely to be trapped near depots while LGB is being trapped more widely across the landscape transect," he said.

"This supports the findings from the initial phase of the project which investigated flight activity in a farming landscape in southern Queensland.

"The second trend from the latest trapping work is strong synchronicity of mean RFB and LGB numbers over time, indicating similar responses to weather or other variables."

Conclusions from the second phase of the insect ecology research include:

- RFB and LGB are capable of dispersing by flight away from stored grain although the spatial scale appears to differ for the two species, and this is contributing to gene flow on a scale of 10 to 100 km;
- Seasonal flight activity shows that infestation pressure from flying beetles is present year-round in central Queensland, while in WA flights occur in the warmer months;
- RFB is more likely to be trapped near bulk stored grain, suggesting that this species does not exist in significant numbers outside of bulk storage;
- LGB is being trapped more widely but whether this reflects greater capacity for dispersal by flight or other factors needs to be ascertained; and,
- Findings have overturned assumptions regarding active dispersal in these pests and have implications for the scale at which pest and resistance management must be exercised. ■

THE COMMERCIAL VIEW LEARNING FROM OTHER STATES

SYNERGY Consulting agronomist David Pfeiffer has welcomed this new insect ecology research in Western Australia which aims to increase knowledge about the lesser grain borer and rust red flour beetle – two major pests of stored grain.

David said there was a key need for research to further understand stored grain insects and resistance levels, especially given the trend towards growers using more on-farm storage as a price risk management strategy.

"The WA grains industry must learn from the experience in the eastern states – where there is a more severe problem with grain insects resistant to the fumigant phosphine," he said.

"The importance of aerated and sealed storage as tools to minimise resistance problems cannot be emphasised enough."

David said it was critical that growers with on-farm storage managed stored grain pests to ensure quality seed and insect-free grain for sale.

He said the four key factors for grain storage pest control and grain quality were:

- Hygiene;
- Aeration cooling;
- Monitoring; and,
- Correct fumigation.

"As with many control measures, prevention is better than cure and ideally this begins with hygiene to ensure an uncontaminated start for new season grain," David said. "Aeration is key as, generally, if grain temperature is kept at 18 to 23°C in summer and 10 to 15°C in winter with adequate aeration, insect numbers are most likely to remain low.

"For some older silos, retro-fitting aeration is an option to cool grain and reduce insect multiplication."

David said grain needed regular monitoring for temperature, insects and moulds when it was put into storage.

"Fumigation with phosphine is a common component of many integrated pest control strategies," he said.

"Unfortunately many older silos are not designed to be sealed and cannot be used for fumigation.

"In sealed silos or partially sealed silos, poor fumigation



Synergy Consulting agronomist David Pfeiffer.

techniques fail to kill pests at all life cycle stages, with grain reinfested as soon as larvae and eggs develop.

"To rub salt into the wound, every time a poor fumigation is carried out, insects with some resistance survive, making the chemical less effective in the future.

"The only way to effectively use fumigants like phosphine is in a properly sealed silo to achieve a sufficiently high concentration of fumigant for a long enough period to kill pests at all life cycle stages.

Needs to be gas tight

"A properly sealed silo is one that is gas-tight."

David said growers should perform a pressure test on their silo every year to determine if their silos were gas-tight.

A fact sheet with instructions on how to perform a pressure test is available from the Stored Grain website (www.storedgrain.com.au).

Insects with weak resistance have resistance levels about 15 times greater than non-resistant insects, while those which are strongly resistant are about 400 to 600 times more resistant than non-resistant insects.

David said testing in WA had confirmed a steady rise in grain insects showing weak resistance to phosphine and over the past few years some farms had developed insect populations with strong resistance.

"Across all species tested in WA, up to 48 per cent of the insects have weak resistance," he said.

"This compares with 70 to 100 per cent of insects with weak resistance in the GRDC's northern region, and 53 to 83 per cent of insects with weak resistance in the southern region.

"Strong resistance has been detected in about five per cent of insect samples tested in the GRDC's northern and southern regions."

Phosphine-resistant grain insects eliminated

THE application of commonly recommended management principles has eradicated a strain of grain storage insects with strong phosphine resistance. It is believed to be the first time that elimination of on-farm grain storage insects with strong phosphine resistance has been scientifically documented and confirmed in Australia and possibly the world.

The achievement – involving more than three years of treatment and monitoring followed by a final check of the Western Australian farm – was made by Department of Agriculture and Food WA (DAFWA) staff with support from the GRDC.

The strongly phosphine-resistant red-rust flour beetles (RFB) were detected on a farm near Wubin, in the Dalwallinu shire, through monitoring by DAFWA, conducted with funding by the GRDC and the Cooperative Research Centre for National Plant Biosecurity (CRCNPB).

DAFWA grain storage specialist Chris Newman, who provides information and training to Western Australian growers under a GRDC funded grain storage project, said the resistant population was this year confirmed as eliminated after recommended management practices were applied and silos were sealed.



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Good hygiene around grain storage is vital to prevent insect populations developing.

Standard practice does work

"The achievement demonstrates that applying standard management principles works, and by applying them growers will control insects before they have a chance to develop resistance in the first place."

Chris said the case of strong resistance was one of only a handful which had developed in WA within the past five years.

He said the resistant strain of RFB at Wubin was believed to have developed independently on the farm after the farmer used incorrect phosphine dosing practices to treat the grain – contained in poorly sealed silos – over an 11 year period.

Chris said many strongly resistant strains of insects could be eradicated with label-rate phosphine fumigation, provided the storage facility was gas-tight.

"DAFWA staff took immediate and rigorous action, involving hygiene treatments to remove resistant insect populations in and around silos, and correct phosphine fumigation to eliminate resistance from within the grain bulk," he said.

"They visited the farm at least twice a year to check on silo hygiene and to ensure fumigations were done correctly," he said.

DAFWA senior research officer Rob Emery said the identification of the resistant strain of RFB and its eradication showed that growers' money – through the GRDC research levy – was being spent in a way that benefited them directly.

"Our project is very applied in that it is focussed on determining resistance by whatever means possible, and then doing something about it," he said.

"Early detection of resistance is one of the strengths of the inspection process we have in WA – we can track the rise of weak resistance and make the grower aware of an emerging problem.

"When strong resistance has been detected we initiate a survey of the area to ensure it hasn't spread."

Rob said monitoring for resistance in stored grain insects in WA was continuing. He said strong phosphine resistance remained minimal in WA, unlike the eastern states.

"WA farmers have worked really hard for years to minimise phosphine resistance and as a result there have only been a few cases of strong resistance reported," Rob said.

"This gives our grain a unique edge, as it can be marketed as free from pests and contact chemicals."

Rob said research had shown that strong phosphine resistance developed when the frequency of weak resistance approached 80 per cent of strains tested.

"The frequency of weak resistance across all species in WA recently reached 45 per cent," he said. "But 73 per cent of RFB are weakly resistant and therefore this species is at the greatest risk of becoming strongly resistant."

Treatments used in the eradication

Hygiene treatments used at the Wubin farm to eradicate the resistant RFB population included:

- Pressure washing inside empty silos, storage surrounds, handling equipment and machinery;
- The application of contact chemical insecticide to kill insects in grain residues at the base of silos, and the removal of waste for burial;
- Treating clean, empty silos with diatomaceous earth protectant to prevent reinfestation.

Insect eradication, with phosphine, was ensured by:

- Silo maintenance including rubber seal replacement on removable hatches and permanent sealing of other gaps with flexible waterproof sealant;
- Silo pressure testing to ensure an extended fumigation period, verified by gas monitoring. ■



It is important to ensure that the silos pad is clean and that seal plate clamps are in place before loading grain.

Plant genetics the answer to using salty groundwater

WHILE many broadacre farmers deal with the problems of salinity, it's also the curse of southern NSW tomato grower Brad Stillard. So much so that he applied for a 2011 Nuffield Scholarship to try and help solve the problems salinity was posing.

"We currently grow tomatoes with saline groundwater and I was interested in finding out what I would do if that salinity increased and how I could manage to keep ourselves productive."

Brad grows tomatoes on his Barooga property, just across the Murray River from Cobram, with groundwater which has a salinity level of 4.2 dSm. This, Brad says, is close to the limit commercial tomatoes will tolerate, so any increase would require an in-depth understanding of salinity and how to manage it successfully.

The good news for Brad was that there are excellent examples of saline water management around the world – it was just a matter of jumping on the plane and starting his Nuffield journey.

Experienced managers of saline water

"I tackled it by going to areas that have been dealing with saline water for a long time – most of the Middle East have been dealing with salinity for decades and so I went to those sort of places looking for some answers to see how they handle it."

Brad says he decided to not just limit his research to tomato crops, believing there could be plenty of lessons learnt in how other crops are managed in saline conditions.

Interestingly, much of Brad's findings centred on the importance of genetics.

"Most of the key things that I've found is that genetics, or salt tolerance, is extremely important – it's probably 60 per cent of the total of growing a crop, and 40 per cent would be the farmer.

So if you've got good genetics, you have good plants in place with good salt tolerance – it makes it a lot easier to deal with salinity."

Soil conservation

Brad says he also studied soil conservation practices, with a view to assessing how much of an impact his current production system is having on his soils.

"I investigated just how much of an effect on the soil and soil health I'm having and just how much destruction or devastation I'm causing out there. The preliminary research that I've done on my own property is that I'm actually not degrading my soil as much as I thought I was – so if I'm getting anything out of this, it's that perhaps some of my current practices are actually heading in the right direction and it's just a matter of improving them."

While the main thrust of Brad's research was the importance of having the right genetics when growing crops in salty water, there's also the other end of the problem to consider too – the salty water itself.

Back pocket is the main driver

But the primary consideration for most farmers is the back pocket, and so searching for a solution to desalinate his groundwater proved unviable.

"I purposely didn't look at reverse osmosis, which is basically filtering out all the salt, because in my business I would examine the cheapest option first and the cheapest option first will be to just modify my current practices.

So I kept my focus on management so someone reading my Nuffield report, can go out and do something with my findings.

Down the track if salty water graduates on to be a bigger problem, then perhaps I will have to consider reverse osmosis or another solution."

Having completed his Nuffield report, the challenge for Brad of course is to put into practice some of his new-found knowledge.

Salt tolerance under our noses

He says the way forward may not be necessarily in the laboratory but perhaps by simply searching for crops naturally suited to salty water.

"I've found some canola varieties that are grown in Australia – and while they're not promoted as being salt tolerant – I have seen them in trials demonstrating good salt tolerance.

So I wonder just how many varieties of different crop species that we're currently growing are actually quite salt tolerant. If we can just identify them and modify some of our management, they could perhaps open up some saline land and more uses for salty water."

Nuffield Australia is an organisation which provides opportunities to Australian farmers between the ages of 28 and 40 to travel the globe investigating a research topic important to them and Australian agriculture.

Brad's Nuffield Scholarship was sponsored by Horticulture Australia Limited through a voluntary contribution from the Australian Processing Tomato Growers and matched funding from the Australian Government.

To read Brad's report see:
www.nuffieldinternational.org/rep_pdf/1310104444BradStillardfinalreport.pdf
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Brad Stillard says there is a lot of untapped potential in using crop species which are naturally tolerant of salty conditions.

Variety selection a key consideration for 2012

GRDC western panel chairman Peter Roberts has urged Australian growers to think particularly carefully about which grain varieties to retain for seeding in 2012. He said seasonal conditions in 2011 had highlighted the susceptibility of some crop varieties to diseases such as barley powdery mildew and rust, as well as quality issues such as pre-harvest sprouting and low falling number.

"In addition to yield and time of seeding, it will be important for growers to consider disease resistance and grain quality when deciding which varieties to seed in 2012," Peter said.

Barley powdery mildew caused some losses in 2011 for a number of reasons:

- Weather conditions;
- Farmers growing susceptible varieties such as baudin; and,
- The disease having developed resistance to triazole fungicides.

"If at all possible, growers should avoid the use of barley varieties rated susceptible or very susceptible in mildew-prone areas," Peter said.

He said the moderately resistant malting variety Buloke was a good alternative for growers wanting to minimise fungicide costs, if they lived in an area suited to this variety.

Seed for new barley varieties with levels of resistance to powdery mildew would also be available in limited amounts for the 2012 season.

Peter said growers who chose to retain susceptible varieties would need to use effective seed dressings such as Jockey at full rates, and spray powdery mildew early with fungicides such as Opus, Opera, Amistar Xtra and Prosaro, which remained effective against the disease.

"Expect to use two or three sprays, and use different fungicides each spray," he said. "Do not use tebuconazole to control mildew."

Consider rust susceptibility as well

Peter said growers should also be mindful of the susceptibility of cereal varieties to rust, following incidences of wheat stem rust and leaf rust in 2011, especially in central and southern grain growing areas of WA.

Peter said growers could also access a number of resources for information about varieties better able to withstand poor harvest weather, as experienced in 2011.

He said some cultivars of wheat and barley were particularly prone to pre-harvest sprouting, and growers should assess the risks of keeping these varieties for future plantings.

"While no wheat varieties are resistant to sprouting, there is significant variation in their susceptibility to the problem, with traits such as head type and inherent falling number being important factors," Peter said.

"But growers who have harvested grain affected by sprouting in 2011 are urged to think twice before throwing out varieties which are otherwise well suited to their farming systems.

"Also, with sprouting influenced by crop maturity at the time of rainfall, growers are advised to choose varieties with a range of maturity types to minimise the risks."

For more information about the susceptibility of barley varieties to powdery mildew, as well as rust, growers could access the Department of Agriculture and Food (DAFWA) bulletin *Barley Variety Guide for WA 2012*, available on

the DAFWA website (www.agric.wa.gov.au) via the 'Bulletins' link on the 'Publications' tab.

More information about varietal resistance to rust was available in the *Barley Variety Guide for WA*, and the *Wheat Variety Guide 2011*, which will also be available on the DAFWA website, through the 'Crops' section.

As well, growers could access objective information about varieties, generated from GRDC-supported National Variety Trials (NVT), at www.nvtonline.com.au



GRDC western panel chairman Peter Roberts.

New HRZ Wheats Prime time to chairman bust rust

SPECIALIST wheat breeding company HRZ Wheats Pty Ltd has appointed a new chairman as it continues to develop new wheat varieties that will help growers in high rainfall zones achieve improved yields.

Bruce Cairns, who is also National Seed and Farm Technology Manager for Landmark, was appointed HRZ Wheats' Chairman in October. He has been part of the HRZ board since Landmark became an investor in 2009.



Bruce Cairns.

"There are over four million hectares of land currently cropped in Australia's greater-than-500 mm high rainfall zone," Bruce said. "Compared with the traditional wheat growing areas, there hasn't been a lot of focus on wheat breeding in this zone in the past. But over the past decade, growth in wheat cropping in high rainfall areas has been very significant. HRZ Wheats Pty Ltd is really focused on breeding milling grade, disease resistant varieties for these regions."

HRZ Wheats is the youngest of Australia's main wheat breeding companies and was established in 2002-03 with a specific charter to meet the needs of growers in high rainfall areas, who currently face disease and yield challenges.

The company is owned by Landmark, the CSIRO, the GRDC, New Zealand Plant & Food Research (NZPFR) and Dow AgroSciences, which came aboard as an investor in September 2011.

New high yielding milling wheat

Bruce said it's an exciting time in the company's history, with the focus over the next year to be on commercialising its new variety, Forrest.

"The varieties available for high rainfall zone growers haven't kept up with the water use potential of those areas, but Forrest has realistic potential to dramatically improve yields of milling quality wheat. Yields in the high rainfall zone typically average between three and four tonnes per hectare, but Forrest has genetics which could see this increase significantly, provided good agronomics are employed."

Forrest promises good disease resistance and is the only wheat variety offering wheat streak mosaic resistance. The launch of Forrest was a welcome reward for eight years of work, Bruce said.

"It's a six-to-eight-year process from the time we start choosing, crossing and selecting lines to the time a new variety gets to market. It's like a funnel – you start out looking at thousands of early lines, then narrow it down each step of the way. Growers in high rainfall zones will soon begin to reap the benefits of those years of work establishing a really strong platform."

Full time positions

The company will announce a full time general manager early in 2012 and has also recently appointed its first full time breeder. Bruce said HRZ Wheats had other promising varieties in the pipeline and growers in the high rainfall zone could look forward to the release of new varieties in 2013 and beyond.

AS we move into the new year it is time to consider last year's crop performance and how each variety stood up to the rust outbreaks that occurred in some regions during 2011.

Growers should reflect on each variety's performance, the effect of rust and management costs and make an informed decision for season 2012.

A recent poll of Australian wheat growers found that 70 per cent make variety selections based on yield potential. But when considering a variety's yield potential, many growers do not factor in the potential yield penalty or costs of a rust outbreak.

Data collected by DPI Victoria has found that the level of rust resistance of wheat varieties has a major influence on potential yield losses in the event of a stripe rust outbreak where no management is undertaken:

- Resistant (R) = 0% yield loss.
- Moderately resistant (MR) = 3%.
- Moderately resistant to moderately susceptible (MR-MS) = 17%.
- Moderately susceptible (MS) = 20%.
- Moderately susceptible to susceptible (MS-S) = 26%.
- Susceptible (S) = 65%.
- Very susceptible (VS) = 70%.

As these figures show, not factoring in the potential losses of a rust outbreak – both in yield and increased controls costs – can be significant.

The Australian Cereal Rust Control Program Consultative Committee's 'Rust Bust' campaign is encouraging growers to phase out susceptible and very susceptible varieties from their rotation because of the risks posed to the whole industry.

But if these cultivars are grown, then a management plan is needed and be ready in advance in case of a rust outbreak.

Experience in south-eastern Australia during 2011 – where there were severe rust outbreaks – showed that rust could be controlled when growers had a plan that involved resistant varieties and/or the use of fungicides.

Growers must also consider controlling the green bridge, fungicide options and communication with neighbours to ensure efficient management. Essentially, grain growers must be more effective managers of the disease to ensure varieties' individual resistance does not breakdown.

Rust becomes a problem in areas where susceptible varieties are grown. They enable inoculum levels to build up on volunteer plants during summer and autumn and give rust an early opportunity to re-establish in commercial crops. Epidemics are more common following wet summers and in wet growing seasons.

Rust can be effectively managed by growing resistant varieties. The level of resistance required varies between regions and these ratings are available online. Often, combining the use of varieties with moderate levels of resistance with the use of fungicides, can provide effective management of rust.

If a farmer is growing a variety that does not have adequate resistance for their region then a rust management plan outlining additional control will be needed.

A grower's individual disease management plan must take into account their property's level of risk, including summer and seasonal rainfall, location and variety selection.

Supplied by Grant Hollaway, Chairman, Australian Cereal Rust Control Program Consultative Committee.

USDA report moves the market, but not the way we wanted

■ By *ProFarmer Australia* (January 18, 2012)

THE mid-January USDA WASDE Reports did not disappoint. For a sixth straight year they triggered a limit move in corn futures prices – with a flow-over impact of similar proportions to the wheat price. This year the price move was down, which is exactly why we (*ProFarmer*) were urging growers to consider selling grain at the recent – and relatively – higher prices.

The risk of prices falling sharply were there ahead of the reports, as the trade bought corn and other grains going into the report, pushing up prices a little, but leaving the market very vulnerable to downside if the unexpected was reported.

In the end the 'unexpected' was the outcome, and corn prices fell, dragging wheat down as well. Soybeans also fell, allowing canola prices to also ease, erasing the gains over the Christmas period.

Of course it could have gone the other way as well, which is why no-one suggested selling all grain on hand ahead of the reports.

But we have to now assume that it will take some time before prices can return to the levels seen in the first week or so of January. Basically it will take a new round of weather scares from South America (current crop) or North America (new crop) to sustain a rally in the market to above the levels seen in the first two weeks of January.

WASDE corn report

Corn traded limit down (40 USc per bushel) on Thursday, January 12, when the USDA Report was released. Prices fell another 12 USc/bu on the Friday night ahead of their long weekend.

Total losses for corn for the week were 44 USc/bu.

The markets in the US had been expecting a reduction in average corn yields in the USDA Reports, but instead corn yields were lifted by 0.5 bu per acre, along with a 45,000 acre increase in the estimated acreage harvested.

In total, US corn production was increased by 48 million bu, not decreased as had been expected by the market.

Exports were increased against higher exports to date and expectations that a smaller crop in Argentina will push more demand back to the US. In the end, US corn stock estimates were lowered just two million bu.

Globally corn stocks were lifted one million tonnes, although corn production was lowered three mt in Argentina, against hot dry conditions to date. Recent rains and cooler weather are reported to have stabilised their crop now.

Hot weather conditions have returned this week, but if the next rainfall event, forecast for the coming weekend, delivers, most regions will get enough rain to prevent serious crop stress from returning in the short term.

WASDE wheat report

Wheat fell 36 USc/bu after the bearish USDA Report. Prices fell another 2.75 USc/bu on the Friday night.

Higher exports offset smaller than expected wheat usage

for feed in the US, delivering a slight drop in US ending wheat stock estimates. But at 23.6 mt, US stocks were still above trade expectations of 22.6 mt.

Global wheat supplies were raised 2.7 mt with increased production estimates for Kazakhstan, Brazil and Russia. The record crop in Kazakhstan should see more domestic use there because the grain will be hard to store. As a result, global consumption estimates were lifted by one mt.

In the end though, it meant another 1.5 mt was added to global stocks.

In their first estimate of new season crop production, the USDA pegged the planted acres for the winter wheat crop at 41.947 million. This is about a million acres more than expected by the trade and is up 12 per cent in area from the 2010 season.

This big lift in acres came from drought stricken areas in the south, and was a response to higher prices (in US dollar terms at least) for wheat.

In the mix of acres, HRW wheat is up six per cent, and SRW wheat is down two per cent reflecting the respective price outlook in these markets.

All things being equal, US wheat production should be higher in 2012 than in either 2010 or 2011. That should see wheat output go from around 54 mt to over 60 mt.

Any drop in consumption due to reduced feed use in 2012 would increase the chances of US stocks lifting significantly by May 2013, particularly if US corn supplies increase this year.

WASDE soybean report

Soybeans prices only fell 20.5 USc/bu after the USDA Report which was not seen as particularly negative for soybeans.

But prices fell another 22.5 USc/bu on the Friday night as rains swept across Argentina.

US soybean production estimates came in as expected at 83.2 mt. This is down from 90.6 mt in 2010–11 and 91.4 mt



The current world soybean price is linked closely to rainfall in South American production regions.

in 2009–10. Ending stocks came in at 7.5 mt against 6.3 mt expected by the trade.

Global production estimates were lowered with reductions for both Brazil and Argentina. But their crops will still be the second largest on record. The drop in soybean production has more than offset an increase in sunflower and canola production.

Soft durum outlook

The acreage planted to durum so far (Arizona and California) in the US is up 15 per cent compared to 2011, and up 24 per cent on 2010.

If this increased acreage results in a similar lift in output, it will reduce the volume of durum imported from Canada. If the Canadian crop also rebounds – which is likely given the current high durum prices – it could significantly lift the exportable surplus from Canada.

The washup from all that could be that by our harvest in December 2012, durum prices could be much lower than for the harvest just completed, particularly if prices for most other bread wheats are also softer. Durum could get hit with a loss of premium, as well as a lower base price for wheats in general.

Wheat struggling

The wheat market has a lot of work to do to get back to the levels seen either side of New Year.

In many ways 2011 is very similar to the 2009 harvest. The global market was similar, with low basis levels triggered by exports from Ukraine and Russia, and rising global wheat stock estimates putting pressure on prices as well (Figure 1). Recovery only came late in the year when the Russian drought set in and exports were banned. It basically took until July to get back to the average levels seen in December.

In 2009 the harvest average price for APW was \$214.86 per tonne. (This year's Nov/Dec average in the same port zone was \$214.36 per tonne). Prices then peaked at \$217 per tonne ahead of the January 2010 USDA WASDE Report before entering a sustained downward price trend that was not broken until April.

The only way to cope with the falling market in 2010 was to revise down price expectations, and sell on the various price spikes during the January–February period. Those growers who were too aggressive with their pricing, ended up selling in May for \$10 less than the February price and in the process, added \$8 per tonne to their holding costs.

The only reason prices then recovered into the 2010 harvest was the drought in Russia, and the anticipated rundown in global stocks in the 2010–11 season.

It will take a drought in Australia – or preferably some other

major exporting country – to match the price gains seen in July–August 2010.

This year the logic says that tight corn stocks in the US will support wheat prices, preventing them from falling in the way they did in 2009. But corn use is being rationed at current high prices. And at current high corn prices relative to soybeans, the corn acreage in the US should not be a problem this year.

The most likely driver for higher wheat prices in 2012 will be crop production issues in the northern hemisphere. As in 2010, that might not manifest itself until the middle of the year. If we hold wheat in expectations of a drought, and it does not happen, we will have lost even more value on the unsold grain from the 2011 harvest, as well as losing value on the crop in the ground.

Global wheat trends

We often hear about the ever increasing level of global consumption of grains, but in the case of wheat, production has been increasing at a comparable rate, to the extent that in the last five years production has been very close to, or above, annual consumption levels (Figure 2).

The net result is that even though the current surplus over production is a modest 10 mt, the five year average is at its highest level for many years (Figure 3).

The main difference between the trends in production and consumption is that production is more variable. That can give us individual years when stocks tighten enough to trigger short term higher prices.

Another point to note is that consumption can fall year on year, particularly after a year of rapidly increasing consumption.

The 2012–13 year looks vulnerable to having production increased against higher acreages planted and a return to normal seasons in Europe and North America, and consumption flatlining, or only growing modestly as feed use swings from wheat back to corn.

FIGURE 1: 2009 wheat prices fell post harvest

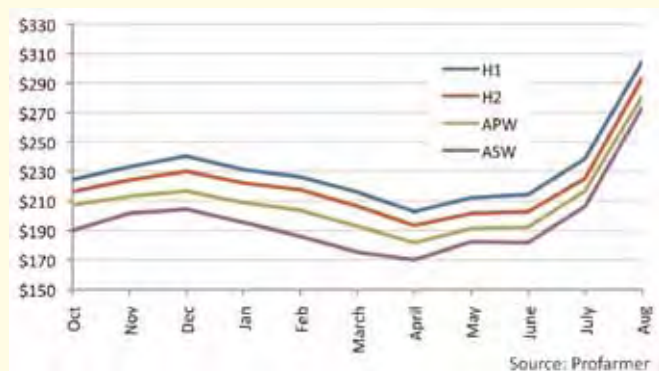


FIGURE 2: Global production and consumption trending together

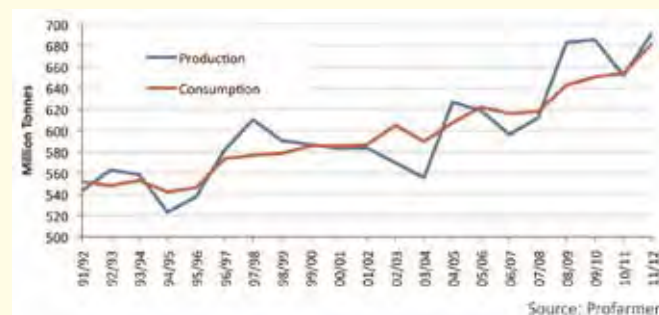
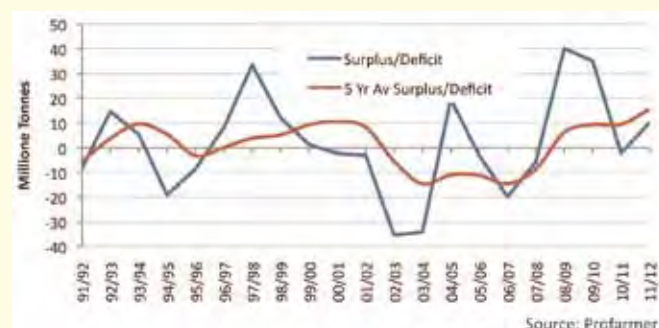


FIGURE 3: Average surplus at a peak in 2012



Domestic grain market outlook

■ Feed barley

Feed barley prices are holding up well against the drop in wheat prices since last week, extending the faster rate of gain in value relative to APW wheat (Figure 1).

From a \$30 per tonne discount to APW in early November, we are now seeing F1 barley at just a \$6 per tonne discount to APW in the Pt Adelaide export zone. This probably reflects the continuing demand for bulk exports, while the trade is probably well covered for immediate shipping needs for wheat, given the stocks they hold from last year as well as purchases of new season wheat.

FIGURE 1: Barley rallies faster than wheat



■ Malting barley

There has been a glimmer in the malting barley market in the past week. Prices have moved up by as much as \$9 per tonne (Pt Kembla Zone), and in most port zones malting barley gained against feed barley.

In Victoria, Graincorp is chasing Hindmarsh barley, paying a price equal to the best Gairdner malt price, and \$6 per tonne above feed barley. Their Hindmarsh price was actually \$2 per tonne higher than their own Gairdner price on Tuesday, with a \$7 per tonne lift in the Hindmarsh price.

In NSW, Viterra have been making the moves on malting barley in the Pt Kembla zone, pushing the premium over feed barley out to \$12 per tonne. In WA the malt barley market remains subdued, holding just a \$4 per tonne premium to Baudin.

■ Canola

Canola prices have been caught in the crossfire of falling grain prices, and economic uncertainty. Last week was rough on both old and new season canola, with price falls in the \$13–\$25 per tonne range across Australia.

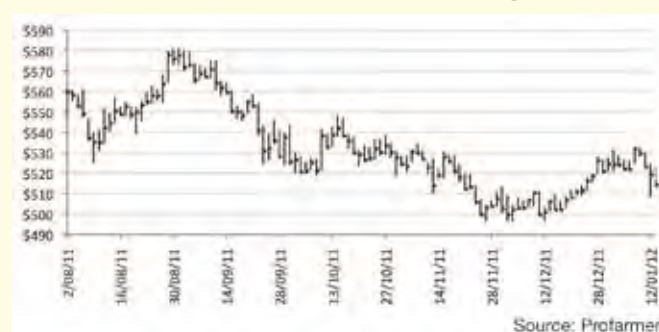
This reversed the price gains seen over the two week Christmas break.

Prices had moved to their highest levels since mid November, giving an ideal opportunity for growers to tidy up the last of their canola sales last week (Figure 2). Now it looks like it will be hard for the market to get back to those price levels without the weather in South America taking a turn for the worst.

The forecasts are hopeful for rains next weekend in South America, so where prices go in the near term might hinge on

whether those rains deliver or not. If they don't we might see both corn and soybean prices recover enough to push canola prices back up. But at the moment the ground that now has to be covered is around the \$15 per tonne mark.

FIGURE 2: Canola futures down over past week



■ Pulses

Peas hit by currency

The pea market is somewhat subdued in light trading, as per the Australian market where prices eased \$5 per tonne over the past week. Volatility in currency markets is not helping some players in the pea market.

But for a non drought year, pea prices have been, and still are, strong (Figure 3). This has also been observed in Canada, where Canadian farmers are enthusiastic towards the crop at the moment. There is a risk that price expectations for 2012 will be too high on the back of the 2011 experience.

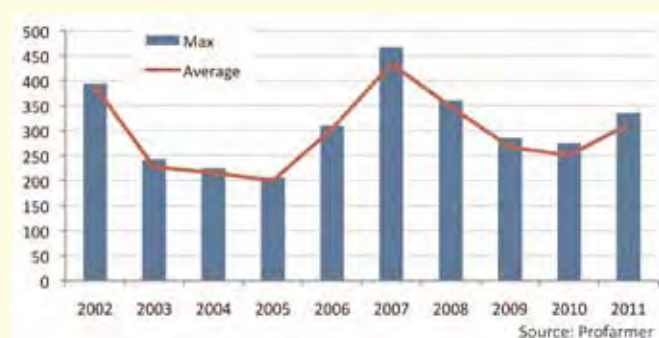
Lentils slow

Reports from overseas are saying that the lentil market is currently as slow as it has ever been at this time of the year. The lentil market normally slows during December and January – but apparently not quite as much as we're seeing this year.

In Canada there is limited trade in 2010 lentils, with preference being given to downgraded product because of the low prices.

The slug of low grade lentils in the Canadian market has been an issue (as it has in Australia from the weather damaged 2010 harvest as well), and the market is keen to see whether growers have diverted their product off to livestock uses in recent months. ■

FIGURE 3: 2011 pea prices strong



Recent trends in tillage

■ By Miles Noller

ENGINEERING has made Australia a world leader in conservation tillage and zero-till cropping. Ever since 1980 when three professors and a technician from the US state of Nebraska toured Queensland and New South Wales, reporting on the equipment that they had trialled for zero-till planting into standing stubble, Australian farmers have increasingly adopted these systems.

They have been supported by dozens of Australian tillage and planting equipment manufacturers, and agricultural engineers who have refined ground engaging tools, stubble handling ability, and the practice of tramlining or controlled traffic to reduce soil compaction to permanent tracks.

Australian engineers are now researching a new generation of issues that are emerging after decades of no tillage and the control of weeds with herbicides.

Many of these research projects were detailed at the recent Biennial Conference of the Australian Society for Engineering in Agriculture, in line with the conference theme: *Diverse Challenges, Innovative Solutions*.

In contrast to the Australian situation, engineers around the world are just now seeking to introduce conservation agriculture technology into developing countries as demand for food around the globe increases. But for this wider uptake of conservation agriculture technology to occur, the use of tractors and machinery in developing countries needs to increase.

Agricultural engineer with the FAO in Rome Josef Kienzie, told the conference that the use of tractors in parts of Africa had actually declined in recent decades. He said in sub-Saharan Africa in 1980, there were two tractors per 1000 hectares of arable land, but by 2003 this had dropped to just 1.3 tractors.

"By comparison in the Asia and Pacific regions, in 1980 there were 7.8 tractors per 1000 hectares and this rose to 14.9 by 2003," Josef said.

"In 1960, Kenya, Uganda and Tanzania alone had more

tractors in use than India. But by 2005, India had 100 times more tractors in use than the total number in these three countries.

"In Central Africa an estimated 80 per cent of cultivated land is worked manually. In eastern and southern Africa it is about 50 per cent," Josef said.

Australia also has issues

These might seem like 'old-fashioned problems' for highly mechanised and quite sophisticated Australian farmers. But the no-till revolution of which Australia is a leader, is producing its own issues of concern.

In Australia it is estimated that 10 million hectares of cropping land is worked using no-till systems, and engineers are seeking solutions to what might seem like old-fashioned problems, such as controlling weeds with tillage as weeds show resistance to herbicides.

There are reports that some farmers are resorting to old-fashioned methods, counter to conservation tillage principles, such as burning stubble every few years to control diseases like rust and crown rot.

Physical weed control

Newly elected president of the Australian Society for Engineering in Agriculture, Glen Riethmuller, says a group of farmers in one Western Australian wheat belt region is using large mouldboard ploughs to turn over the soil and bury the weed seeds deep below the surface.

Glen, from the Department of Agriculture and Food in Western Australia, also reported to the conference on research that has looked at physical weed control in wide row lupins.

But he said the mechanical cultivating between the lupin rows has not satisfactorily controlled the seed-set of wild radish. He said the wild radish left in the row produced high seed numbers, and he thought that pre-emergence herbicides or other techniques needed to be tested to reduce in-row weeds.

Controlling ryegrass seed set

Glen has also been involved in a project to test the effectiveness of desiccation and swathing of canola on viable annual ryegrass weed seed numbers at harvest.

He reported that desiccation in a trial at Katanning reduced annual ryegrass seed set by 78 per cent, and in another trial at Mt Barker under slightly different conditions, the reduction of ryegrass seed set was 50 per cent.

The project showed that swathing (rather than direct harvesting) reduced the remaining in-field ryegrass seed set by 98 per cent at Mt Barker where the ryegrass was very tall, but 57 per cent of the ryegrass seed in the swaths was viable.

At Katanning only 10 per cent of the ryegrass seed in the swaths was viable.

"The yield of the swathed treatments was lower than direct harvesting with or without desiccation at Katanning, but was not significantly different at Mt Barker, which was swathed relatively late," Glen reported.

Single disc seeders

Research at the University of South Australia is seeking to improve the performance of single disc seeders in sticky soil conditions.



Glen Riethmuller (Department of Agriculture and Food, Western Australia).

Ali Khosravani Goshtasb from the research team at Adelaide said handling of sticky soils by disc seeders was still a major limitation for zero-till farmers in Australia.

"Reported problems include uncontrolled soil build-up impairing proper seed placement and increasing depth variability of the seeding disc modules."

Ali said gauge wheel interaction with the disc increased the soil build-up on the disc.

The project also tested a polymer coated disc which showed less soil build-up than the steel disc.

He said the experiment showed that load on the gauge wheel was a factor with greater pressure resulting in more soil build-up.

The investigation of the positioning of the gauge wheel and the pressure on the wheel needed to be undertaken to reduce soil throw and depth variability.

Narrow point opener angles

Another University of South Australia project is seeking to determine the most effective rake angle of narrow point openers in zero-till equipment.

Team member Aliakbar Solhjoui said Australian no-till farming often uses narrow point openers to open up the soil, and place the seed and fertiliser in the furrow. They are generally used in conjunction with spraying of herbicides for weed control and press wheels to pack soil over seeds.

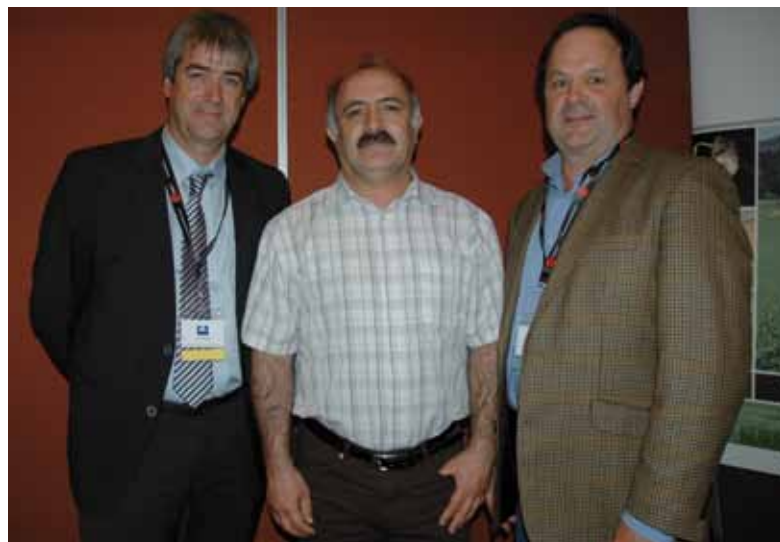
"These openers can create excessive soil disturbance and soil throw, reducing the quality of no-till farming, by increasing depth of soil cover on adjacent furrows, increasing stimulation of weed seed germination, and enhancing seedbed soil moisture loss," Aliakbar said.

He said excessive lateral soil throw at seeding can result in herbicide contaminated soil being thrown onto adjacent seed

rows. To reduce these problems less lateral soil movement is required.

The research looked at flat face narrow point openers with rake angles of 35, 53, 72 and 90 degrees.

The results were varied, with different rake angles moving bottom, middle and shallow soil levels differently. An intermediate rake angle of 53 degrees produced the widest furrow zone cleared from surface soil, which might result in the safest use of pre-emergence herbicides incorporated by sowing. ■



Presenters at the recent conference of the Australian Society for Engineering in Agriculture, are from left: Josef Kienzle (FAO, Rome), Ali Khosravani Goshtasb (University of South Australia) and Troy Jensen (NCEA, Toowoomba).





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* Results from Keating Family Farm, Russell, Manitoba, 2010.
Full article: Bourgault Cutting Edge Publication
Winter 2010/Spring 2011, Page 13; "The Root of Success".

PRESERVING A NEW HERBICIDE FOR FUTURE GENERATIONS

■ By Neree Martinez, Australian Herbicide Resistance Initiative

THE world population is set to increase to a predicted nine billion by 2050. Sustaining and increasing global grain production will be vital in feeding this growing population. For the past 40 years herbicides have provided effective weed control in global grain crops. But continued heavy reliance on herbicides has resulted in widespread herbicide resistance in weeds, threatening grain production.

Many grain producers around the world are under the assumption that new herbicides will continue to be discovered. But this is not necessarily the case, highlighting the need to preserve our existing herbicides for future generations.

But thanks to an extensive international research collaboration, a promising new herbicide – pyroxasulfone – is about to be released in Australia. The new herbicide will be registered in Australia for use in 2012 as Sakura by Bayer CropScience. It is a new wheat selective pre-emergence herbicide used for the control of annual ryegrass, including populations with resistance to multiple modes of action.

A world first

This article outlines AHRI's research in assessing the potential for resistance to Sakura to evolve in the major Australian weed species, annual ryegrass. This research is a world first in that the resistance evolution risk has been evaluated in a herbicide prior to its commercial release.

Never before have we been privileged with such information prior to a herbicide's commercial release. It is essential we use this knowledge to our full advantage in order to prolong the life of Sakura.

Experiments to determine the potential for resistance to Sakura to evolve were conducted by AHRI researchers Dr Todd Gaines and Dr Roberto Busi.

This research was conducted in collaboration with Kumiai Chemical Company, with funding from the Australian Research Council (ARC) and the GRDC.

High dose screening

Experiments were conducted to determine if there were any major Sakura resistance-endowing genes in a large susceptible population of ryegrass. This was done by screening over 100 million individuals treated with a high rate of Sakura.

The high-dose screening experiment established that no major-effect resistance genes were present in the 100 million individuals tested. This means the frequency of major resistance-endowing genes in Sakura was low (in contrast, the chance of major-effect ALS resistance genes being present is much higher, at around 1 in 10,000 individuals).

This suggests that strongly Sakura-resistant individuals in a completely susceptible population are rare.

Low dose screening

A low dose experiment was conducted using pot

AT A GLANCE

- Sakura is a good herbicide – but like all other herbicides, resistance to it can evolve;
- Always use the full label rate and in conjunction with an integrated weed management system; and,
- Rotate with Boxer Gold and trifluralin to sustain Sakura for future generations

experiments to evaluate the potential for resistance to evolve by three years of recurrent selection at sub-lethal rates.

A fully herbicide-susceptible ryegrass population and a multi-resistant population were recurrently selected with low rates of Sakura for three generations. Plants surviving herbicide application were allowed to cross-pollinate to produce seed which was tested for herbicide resistance.

The low-dose screening experiment established that using Sakura at cut rates will lead to resistance evolution. In both populations screened, a shift towards resistance was demonstrated when Sakura was recurrently applied for three years at cut rates. But there were differences between the level of evolved resistance in the susceptible and multi-resistant populations (Figures 1 and 2).

FIGURE 1: Sakura selected progeny of the herbicide susceptible population (starting from left, progeny 0, 1, 2 and 3) following three cycles of recurrent selection at low Sakura doses



FIGURE 2: Sakura selected progeny of the multi resistant population (starting from left, progeny 0, 1, 2 and 3) following three cycles of recurrent selection at low Sakura doses



This experiment highlighted that the persistent use of Sakura at sub-lethal rates will lead to the rapid evolution of a resistant population of annual ryegrass.

Previous research by Roberto Busi has documented a similar pattern of resistance evolution when cut rates of diclofop and glyphosate were applied to ryegrass. Ryegrass is a highly genetically variable, outcrossing species with several resistance-conferring mechanisms, enabling some plants to survive herbicide application. These plants, with potentially different mechanisms of resistance, have the ability to cross with each other leading to the rapid evolution of a more resistant population. This is attributed to a progressive accumulation of resistance endowing mechanisms in plants infesting a paddock.

The use of cut herbicide rates on ryegrass can have severe consequences in resistance evolution as it allows a greater multitude of plants to survive and exchange traits enabling resistance.

This practice is considered detrimental for herbicide sustainability and should be avoided at all costs.

Prolonging the life of the new herbicide

To sustain the life of Sakura it should always be applied at the full label rate and be rotated with other pre-emergent herbicides such as Boxer Gold and trifluralin. Most importantly, it should be incorporated as part of an integrated weed management plan also containing non-herbicidal tactics, such as harvest weed seed management.

Sustainable use of Sakura and other herbicides is vital to ensure a viable future for grain production globally. This is essential to meet the growing demands of feeding our increasing world population. ■



(From left) AHRI researchers Dr Todd Gaines, Dr Martin Vila-Aiub (Visiting Researcher at AHRI) and Dr Roberto Busi. Todd and Roberto were the major researchers on the Sakura project.

FORMER AHRI 4th YEAR WINS NUFFIELD SCHOLARSHIP

Jemma Sadler is the West Australian recipient of the 2012 GRDC-sponsored Nuffield Scholarship and will use this opportunity to travel overseas to investigate sustainable weed management.

A former University of WA, and AHRI student, Jemma now farms a mixed cropping and livestock property in Wongan Hills with her father and brother and knows 'first hand' that weeds are a barrier to profitable cropping.

Through the Nuffield Scholarship, Jemma hopes to better understand the potential limitations to weed management with continual herbicide use. "Herbicides around the world continue to be over-used, but despite integrated weed management being well studied and documented they still remain the cheapest and most effective control tool," says Jemma. "Although Australia is a world leader in research into integrated weed management, I would like to investigate how other countries are profitably controlling their weeds."

"I would also like to see how other countries are handling the integration of GM growers with non-GM growers and how these different farming practices can co-exist."

Jemma will embark on her scholarship travels in February/March to England and Germany, before flying to the US, Canada and South America.



Jemma pictured in a wheat crop on her Wongan Hills family property.

GLOBAL RESISTANCE CHALLENGE COMES TO PERTH

Herbicides are the principal tool for crop weed control yet their sustainability is threatened by the evolution of herbicide resistant weed populations in many parts of the world. The Global Resistance Challenge 2013 conference offers a multidisciplinary forum focused on all aspects of herbicide resistance in crops and weeds and their impact on global food production.

The ARHI, based at The University of Western Australia will host this conference. We welcome everyone who wishes to discover the latest advances in herbicide resistance to Perth in February 2013.

KEY DATES

■ Conference being held	February 18–22, 2013
■ Early Bird Registration Opens	March 1, 2012
■ Call for Abstract Submission	March 1, 2012
■ Abstract Submission Closes	September 30, 2012
■ Early Bird Registration Closes	September 30, 2012
■ Standard Registration Opens	October 1, 2012

To register your interest go to: www.herbicideresistanceconference.com.au

A career in agriculture – what does the future hold?

■ By Sally Davison, Australian Farm Institute

A COMMON adage is that there are two things in life that are certain – death and taxes. But perhaps there are three – death, taxes and the fact that everyone has to eat. It is tempting to think that this third inevitability means farmers will never be out of a job, but it's interesting to consider how the nature of the agricultural profession has changed over time, and what this means for those interested in working in the industry.

As those who arrived in Australia in 1788 quickly discovered – and as farmers have been learning ever since – Australia is not always an easy place to grow food and fibre. But despite the difficulties encountered by the early European settlers, Australians have continuously enjoyed an abundance of locally-produced, safe, cheap and high quality food. The efficiencies and advances Australian farmers have made in agricultural production mean that Australia's 130,000 farmers produce sufficient food for more than

60 million people, and sufficient fibre for many times that number of people.

The methods used to produce food and fibre on Australian farms have changed significantly over time, and with it, what it means to work in agriculture. This is also true of other occupations. You don't tend to see many telegram deliverymen, petrol station attendants, switchboard operators or chimney-sweeps these days.

These are some of the many jobs which have become extinct over time, through the development of new technologies or even new industries.

Farming is an occupation that has survived through the ages, but the work of a farmer today is vastly different to that of a farmer in the 19th century. Few people working on farms today can shoe a horse, or sow up a bag of wheat, or work a cross-cut saw, or use an adze to shape a fence post, but these were all important farm skills a little more than 50 years ago. On the other hand, farm workers 50 years ago never had to calibrate a boom spray, read a yield map, download CBOT wheat prices, or analyse the fertiliser needs of a paddock based on soil tests.

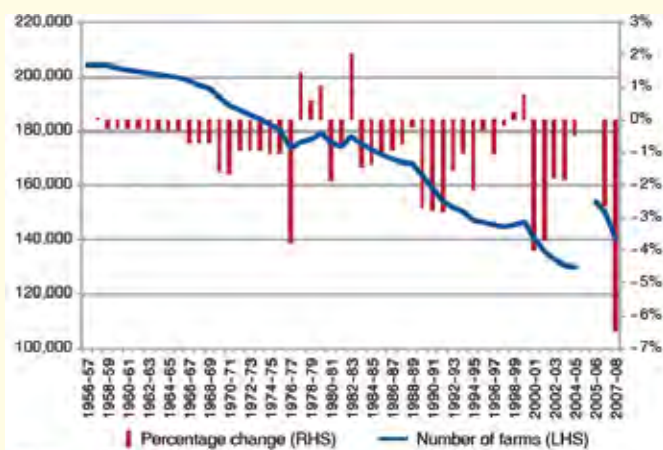
Agriculture is an industry which perhaps best demonstrates the impact of technology on the nature of an occupation. Not only has the number of people working directly in agriculture changed, but also the types of jobs, the proximity of these jobs to farms, the level of education required of workers, and the technologies that a farmer relies on.

Analysing what and how productivity changes have been made in the sector may provide clues as to how the sector is going to evolve in the future, and what that will mean for a future career in Australian agriculture.

Productivity – what's it got to do with work on farms?

In the second half of the 20th century, global population and therefore food demand grew at an unprecedented rate. Yet despite this enormous growth, agricultural production kept pace,

FIGURE 1: Change in the number of farms in Australia from 1956–57 to 2007–08



Farming is an occupation that has survived – and adapted – through the ages. A historic photo of the revolutionary Big Four tractor operating at the beginning of the twentieth century in the Parkes district. This was a great technological advance for the time. (Photo: Courtesy Pioneer Park Museum, Parkes, NSW)

in fact increasing beyond what was required, with the result being that inflation-adjusted food and fibre prices fell significantly over this period. How did this occur? The answer is that productivity gains made in agriculture have a lot to do with it.

Productivity is a measure of the efficiency of the conversion of inputs to outputs. Productivity growth involves increasing output from a given level of inputs, and these inputs include labour.

Over the period from 1975 to 2004, the Australian agriculture sector achieved the second highest rate of productivity growth of any industry sector in the Australian economy. Australian agriculture has achieved productivity growth levels up to four times higher than the average for the economy as a whole.

Much of the productivity growth that has occurred in Australian agriculture over recent decades has been in terms of outputs per unit of labour, which has occurred both as a result of reduced labour inputs, but also due to increases in total outputs.

A consequence of the change has been that the number of farm businesses has declined as it has become possible for the same number of people to manage a bigger area of land – so the number of people employed in the sector has also declined.

Figure 1 shows the change in the number of farms in Australia from 1956–57 to 2007–08. The analysis is somewhat hampered by a change in statistics collection methodology in 2005–06 which produces the sudden jump in the apparent number of agricultural enterprises. But the overall trend is clear – over the past half century the number of farms has decreased significantly.

While there has been an overall decrease in the number of farms, the size and composition of agricultural enterprises over this period has changed dramatically. Farm businesses have been reducing in number, and increasing in size.

Where do productivity gains come from?

Necessity is the mother of invention. In no other sector is this more true than Australian agriculture. There are many factors which may influence productivity rates in agriculture. These include seasonal changes, infrastructure, education, communications, transport, farm size, improvements in fertilisers, pesticides, new crop varieties and new livestock technologies. Each of these elements, and others, has changed significantly in Australia over past decades.

A combination of a lack of manpower and demand for food during World Wars I and II placed increasing pressure on agricultural systems. The process of planting and harvesting crops, in particular, was revolutionised with the development of the tractor, combine-harvester, delivery of grain by trucks, and the development of sack-loading devices. These changes were all outcomes of necessity.

Despite these significant developments, until the 1960s and early 70s, productivity gains were not keeping pace with

population growth. A big factor in the turnaround was the improvement in plant genetics over this period – the ‘Green Revolution’ – which resulted in more productive plant varieties that responded to improved production practices with increased yields.

The new high-yielding varieties of wheat, maize and rice were introduced commercially into many countries including Australia. This research translated into significant increases in grain production, and coincided with the development of key changes critical to modern agriculture, such as the increased use of pesticides, fertiliser and irrigation.

Increased soil degradation and food shortages in this time also led to a search for sources of elements critical to the growth of plants, including phosphate rock and guano for phosphorous, nitrogen fertiliser produced by synthesising ammonia from atmospheric nitrogen, and sulphur and potassium. The development of mineral fertilisers was a key contributor to increased global crop yields.

In livestock sub-sectors, the past half-century also represented a period of significant changes in practices as a result of improvements in animal breeding, genetics, feeding technologies, and more recently advances in animal disease and animal health management.

Research and development has been a consistent and significant source of productivity growth, contributing to every step of the modernisation process. The rapid emergence of biotechnologies provides an excellent example of the role research and development plays in changing production practices. Modern biotechnology includes the manipulation of whole organisms, groups of cells or cell components. Genetic engineering generally refers to the identification of genes which control particular processes, and the transfer of that gene into another organism. For plants, this opens up major areas for manipulation such as insect resistance or herbicide tolerance.

Genetically engineered crops were made commercially available in 1996, and since then their use globally has expanded significantly. Genetically engineered crop adoption was slowed in Australia due to state government moratoria, but their adoption is now increasing rapidly. As technology continues to evolve more broadly across society, the application of biotechnology in agriculture will inevitably adapt in response.

The future of agriculture will almost certainly incorporate an increasing level of technological advancement.

What does all this have to do with employment?

Over time, developments such as research-induced technical change, changes in infrastructure, levels of education, communication technology, availability of information and advice, seasonal changes, policy environment, investment levels,

TABLE 1: Estimated employment in agriculture by sub-sector, 2001–02 to 2007–08

Sub-sector	2001–02	2002–03	2003–04	2004–05	2005–06	2006–07	2007–08	Percentage change
Horticulture	23.9%	27.0%	28.5%	27.5%	27.4%	27.3%	23.1%	–0.9%
Grain, sheep and beef cattle farming	52.6%	48.1%	49.0%	44.9%	46.4%	46.0%	49.0%	–3.6%
Intensive livestock	9.9%	10.6%	8.8%	10.4%	10.6%	9.7%	10.2%	0.4%
Other livestock farming	3.0%	3.5%	3.0%	3.5%	3.7%	3.4%	2.8%	–0.3%
Broadacre cropping	4.2%	3.8%	3.2%	5.4%	3.0%	4.8%	5.3%	1.0%
Services to agriculture	6.3%	7.0%	7.5%	8.3%	9.0%	8.9%	9.7%	3.4%
Total agriculture	372,397	314,670	312,110	303,138	298,675	307,350	305,763	–3.2%

*Percentage may not add up due to rounding.

SOURCE: ABS and AEC data, as per SEC group, 2010, *Towards a Better Understanding of Current and Future Human Resource Needs of Australian Agriculture*, Research Report, Australian Farm Institute, Surry Hills, Australia



A career in agriculture has evolved from a mainly physical pursuit to one where highly technical skills and aptitude are required.

openness to trade, and uptake of new technologies – have all combined to influence the way people working in agriculture carry out their daily activities. For each factor that influences the agriculture sector, there is an associated skill-set and a job to go with it.

From the colonisation of Australia through to today, the occupations within, and associated with, the agriculture sector have changed significantly. Table 1 shows a breakdown of employment in agriculture by sub-sector from 2001–02 to 2007–08. It highlights that the sub-sector with the largest percentage increase in employment was ‘services to agriculture’.

At the same time, the number of people employed in the grain, sheep and beef cattle farming sub-sector experienced the largest percentage decrease in employment, with agriculture as a whole experiencing a fall in total employment by 3.2 per cent.

Mechanisation within the agriculture sector had a significant impact on numbers of people working directly on farms, but this benefits the farmer and the consumer by freeing money and time that can then be reinvested in other areas of the business, making it more economically efficient.

While this suggests an overall decline in agricultural employment, it does not give an accurate picture of the nature of the jobs, or demand for employees in agriculture.

Demand for agricultural graduates

A good indicator of the demand for employees in a sector is the demand for graduates. A comparison of this with the number of students graduating from agriculture courses shows that demand for workers in the agriculture sector is very strong.

The Australian Council of Deans of Agriculture estimated that Australian universities were graduating less than 800 graduates per year in agriculture and related courses. Yet the demand for graduates is estimated at more than 6000 per year. According to available data, it is estimated that a labour shortfall of 96,000 full-time workers exists in agriculture.

As Australian farms have become increasingly reliant on technology and innovation for their productivity gains, the need for skilled employees has become increasingly critical. The productivity trends outlined above have influenced the skills and education level demanded for a profession in agriculture, though the demand isn’t currently being met.

The Australian agriculture sector is classified as ‘highly skilled’ under the ANZSCO classification system, with 69.1 per cent of those working in the sector employed in level 1 occupations; that is managers, administrators and professionals. Being able to handle a bullock and cart is no longer the most important prerequisite of working on a farm that produces crops – rather an ability to navigate a GPS system is perhaps more important.

What will a job in agriculture look like in 20 years time?

Technological change will continue influencing Australian agriculture and the nature of jobs in the sector. The dissemination of information via the internet and information technology has already had a dramatic effect on agricultural enterprises, which requires employees to be skilled in a range of different technologies.

As a result of the increasing adoption of new technologies and innovations to achieve productivity gains, the agricultural workforce has had to change. The need for highly trained and skilled personnel has become increasingly critical throughout the supply chain, and the educational requirements of farm workers have increased.

Changing trends in consumer demand will also influence the skills required of an employee in agriculture. The average consumer today is considerably more environmentally aware and retailers are responding to the demand for sustainably-produced foods. This often results in the retailer requiring farmers to meet various quality and environmental standards in order to retain access to the retailers’ shelves. This, in turn, means that farm workers need to be able to understand the requirements of these quality systems, and how records need to be maintained and managed to ensure ongoing accreditation.

Using a wrong chemical, or failing to correctly record management activities, can quickly jeopardise accreditation status and could cost a farm business a large amount of money – so staff need to have good literacy, numeracy and computer skills.

As technological change continues at an ever-increasing rate, it’s increasingly unlikely farmers will be able to keep abreast of every new technology development, market demand or retailer requirement. Consultancy or advisory personnel will therefore become increasingly important to facilitate the technology transfer required to keep farms ahead of the competition – a trend that is evident in the data in Table 1.

The pressure to produce increasing amounts of food of very high quality, but with the lowest environmental footprint will also influence the type of skills required of consultants servicing the farm sector. Skills in areas such as environmental assessment, ability to implement standards, and the development of good record keeping systems will be more important in the future.

It’s clear that as each agricultural production change happened, it not only influenced the productivity of the sector, it also influenced the nature of a job in agriculture. What was a very physical job focused on manual tasks, has diversified into many varied roles which require very different levels of technical aptitude.

A job in agriculture will be less likely to be based on the farm, the level of technical knowledge and education required will continue to increase, and the range of technologies an employee will need to be conversant in will grow.

The increasingly sophisticated nature of the agriculture industry provides a great opportunity for young people looking for a challenging career, and this needs to be highlighted in order to attract new industry entrants to meet the projected future demand for agriculture workers.

Further information on this topic is available in the recent report, Towards a Better Understanding of Current and Future Human Resource Needs of Australian Agriculture, available for purchase on the Institute website by following this link – www.farminstitute.org.au/_product_31033/Towards_a_Better_Understanding_of_Current_and_Future_Human_Resource_Needs

An outdoor classroom inspiring the next generation

■ By Sue Knights

THE next generation will be increasingly computer literate and technologically savvy but there is a growing concern that it will be increasingly disconnected from nature. In a bid to improve nutrition and to introduce authentic learning opportunities into schools the kitchen garden scheme sweeping primary schools has become very successful.

Introducing a kitchen garden into the curriculum across all levels enables learning opportunities in almost every discipline.

In a small independent government school in the heart of Perth a newly built kitchen garden is introducing agricultural crops to students who rarely see them. Oberthur Primary School is a hidden gem in Bull Creek and is the nurturing home for some 360 students from kindergarten to Year 7.

In August of 2011, spurred on by enthusiastic teachers, a group of parent volunteers constructed an outdoor classroom for the school.

History and crop improvement

A mystery bag of 'golden grain' given to Year 3 students to grow, was variously identified after germinating, as everything from lettuce to broccoli!

As it developed into a small barley crop it dawned on many of the students that it in fact looked like grass. During the year, as the crop developed, it gave the opportunity for an invited plant breeder to talk to the youngsters.

David Moody from InterGrain, a leading Australian crop breeding company based in Perth, outlined to the students the

history of crop improvement and the move of our society from hunting and gathering to a more settled farming society that we know now – an 'evolution' which has enabled many of the technological advances that we benefit from today.

The web of life and the cinema

The capture of a white cabbage moth caterpillar on a small canola crop by a Year 2 student enabled the unexpected learning opportunity about biological pest control agents.

The caterpillar was infected with parasitoid wasp which subsequently pupated and consumed the caterpillar. After the initial trauma of the demise of the caterpillar the young student learnt (via Google) the significance and value of the wasps as biological control agents and how they reduce the incidence of synthetic pesticides in our environment. This is a highly relevant issue for her family as her little sister is allergic to a range of chemicals in our environment.

The research project went further to discover that parasitoid wasps were the inspiration behind the movie *Alien*.

Plant morphology and technological advances

Whilst harvesting the barley crop an observant Year 3 student commented that the awns felt smooth running your fingers one way but very sticky in reverse. A simple exercise which actively engaged the students in an everyday process.

This led to a discussion of plant morphology and methods of seed dispersal and how the hairs on the awns enable the heads to be caught in animals' coats, or even on us, and be spread further afield.

The conversation developed further into the history of the development of Velcro from a similar moment of keen observation of the hooks on a thistle head.



Lucas Parker Year 4/5 measuring a sunflower at Oberthur Primary School.



Year 3 students with the original overgrown garden bed in the centre of the school.



The outdoor classroom containing wheat, barley, sunflowers, maize and safflower alongside vegetables – complete with water tanks.

Maths, english, art and a developing social conscience

What other agricultural plant could you use to inspire both maths and art in young students but the wonderful sunflower.

Not only is it a quick grower but it is a huge and stunning plant which captures a child's imagination. From measuring them and determining growth rates to keeping a visual diary – to becoming a budding Van Gogh – it is the ultimate in authentic learning subjects!

A year 4/5 class was fortunate to have a progressive teacher with proven experience in such authentic learning experiences.

Upon flowering, several of the magnificent flowers were presented to a local senior citizens' home that the school has regular contact with.

There is no better way to nurture the development of a social conscience in children than for them to give a gift that they have grown themselves.

There has been much discussion in the rural press about the present – and potentially greater – skills shortage in the agricultural industry. Many initiatives to raise the profile of agriculture to students are targeted at secondary students, at a time where students have already been streamed into their chosen subjects.

Inspiration at a younger age

It is time to consider inspiring children at a younger age and opening their eyes to agriculture.

If they are actively engaged in authentic learning exercises at a young age it may be very much easier to maintain or re-kindle that interest through their later education.

In a country which is becoming increasingly urbanised we will become more reliant on a city-based society to provide the bright young brains for the agricultural sector. We need to inspire this younger generation to chose agriculture.

Further information: Dr Sue Knights, SE Knights Consulting Ph 0429 411 971
E:sknights@netconnect.com.au

To fight or flight? Coping with a volatile farming life

■ By Viki Thondley

STRESS: A pesky little word that gets tossed around a great deal in modern-day life. For those working on the land, challenges are presented at nearly every turn as you hope the weather holds off, the wheat is Prime Hard, and the moisture stays below 12.5 per cent. Working in the farming industry often presents challenging moments. When your livelihood depends on working hard – often at all times of the day and night – it is a constant adjustment for the mind and body.

Whether you are harvesting grain at 1am or having to make critical financial decisions for your family farm, we all suffer from some form of stress and anxiety.

The good news is that you can minimise your stress if you choose to. But first, do you really understand stress, and more importantly, how it affects your body?

Understanding the physical side of stress

To combat stress, our bodies have a built-in protection mechanism called the 'fight or flight' response. Normal day to day interactions aren't likely to cause us physical harm, so most of the time our body is (or it should be) in a nice calm state. But, at any time when our senses detect danger is approaching, the body reacts by signalling the brain that it needs energy quickly – to either stay and protect you or run away as fast as it can.

Hence, to 'fight or flight'.

Before your conscious mind even has time to think about what danger you could be facing, your brain has already received the signal and sent out messages to the body in preparation.

These messages are sent via the adrenal glands in the form of hormones: Adrenaline increases our alertness and energy, while cortisol mobilises energy and stimulates the appetite to replace it. This causes the following to occur:

- Heart rate speeds up;
- Blood pressure rises;
- The body heats up; and,
- Muscle cells fill with fresh oxygenated blood.

This automatic physical response happens in a split second, before you're even sure of what you might be dealing with. It's your body's way of preparing itself to protect you.

Modern stress

In prehistoric times this reaction could have meant life or death. In modern life this stress response is activated for longer periods of time because we have a greater level of worry and stress in our lives compared to the basic survival needs of the cave man. Our adrenal gland can't tell the difference between fleeing from a lion, being held at gunpoint or running late for work – it merely generates the same physiological response.

Over time our bodies develop high levels of stress hormones. The result is an accumulation of adrenaline and cortisol keeping our bodies on high alert. This excess of energy production is

physically very demanding as our bodies were not designed to always be prepared or preparing for danger.

Effectively we are placing ourselves under immense mental and physical pressure until our bodies can take no more. This is dangerous for us in several ways because our mind and body don't have a chance to rest and recover.

If the balance isn't corrected we leave ourselves open to a large variety of diseases and disorders directly and indirectly affecting our quality of life. Symptoms range anywhere from:

- Sleep disorders
- Skin diseases
- Heart disease
- Anxiety
- Alcohol or drug dependencies
- Chronic pain
- Stroke
- Depression
- Suicide and cancer

What can you do?

Most people are unaware of how stress levels creep up on them in their daily lives. Day to day little frustrations, hurts, grievances, resentments, disappointments, worries and commitments are felt not just in the mind but also in the body.

Without rest, relaxation or resolution (mentally and emotionally) they are stored and held onto (physically) creating a greater tension and stress within the body. This is the beginning of long term muscular tension and the development of a continued state of stress.

To combat the stress response our bodies need to revert to a stable condition, a state of calm known as Homeostasis or the Relaxation Response – the complete opposite of the stress response. For example:

In a relaxed state:

- The heart rate is slower.
- We don't use as much oxygen because we need less energy.
- We have a greater sense of calm and clarity.
- We can focus our attention more easily.
- Overall we feel relaxed and clear headed.

In a stressed state:

- Our heart rate is elevated.
- We use much more energy and oxygen.
- Our muscles are tense.
- We feel agitated and tired.
- We generally don't have a positive outlook because we're too exhausted and fatigued to gather our thoughts constructively.

Practical stress management techniques

A certain amount of stress is normal and part of daily living but having the stress response activated for prolonged periods of time is not healthy for us. We need to develop effective stress management techniques to protect ourselves from the long term effects of the fight or flight response and live a more balanced, peaceful and productive life.

Even though life is busier now more than ever before, it is essential to schedule daily time for yourself and practice self-care.

Ignoring signs of stress will eventually lead to irritability, lower tolerance levels, increased risk of illness and disease, reduced inner peace, and the inability to focus and manage daily stressors effectively.

Suddenly, minor occurrences will invoke an uncharacteristic or overly exaggerated reaction such as short bursts of anger or frustration. It is essential for your long term health and happiness to effectively manage your stress levels and schedule regular relaxation time.

10 tips for promoting the Relaxation Response

- Ensure adequate sleep to promote rest and recovery.
- Exercise! Energy creates energy, stimulates blood flow and improves mood.
- Learn meditation, yoga or breathing techniques to induce instant calm.
- Recognise the signs of stress in your own body and pay attention to them.
- Write down the issues that are worrying you so you are able to see them clearly.
- Allocate 10 minutes daily to problem-solving any worrying thoughts.
- Eat regularly to stabilise your blood-sugar and increase concentration.
- Make time to catch up with friends and family.
- Every day take 5 to 10 minutes just for yourself and clear your mind.
- Take up or return to activities that you enjoy such as reading, writing or drawing.

By applying just a few of these tips, you'll begin to increase your awareness of just how much stress you are under and how much better you can feel. If left unmanaged, your tension and stress will eventually become so great that you can no longer tolerate what is too painful to ignore.

Your health is in your hands.

For more information on managing and reducing stress, contact Viki at MindBodyFood. Email: viki@mindbodyfood.net or Mobile: 0410 608 022
Visit: www.mindbodyfood.net

DOING A LOT OF TRACTOR HOURS?

- Prevent muscle tension or cramping by taking a few minutes to stretch after each row.
- Take five slow, deep breaths.
- On each exhalation, consciously relax your neck and shoulders by allowing them to drop down.

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Potatoes and broadacre crops chip in for profitable farming

IDAHO claims the number one spot for overall US potato production, but for potatoes that end up as potato chips, Michigan has been the nation's leading producer for years. Every year, fourth-generation potato grower Larry Sackett supplies more than 86,000 tonnes of those Michigan potatoes in an operation that demands intensive management and dozens of pieces of equipment.

Larry thrives on the pace. "The easiest thing I do every day is come to work," he says.

It's a business that his greatgrandparents, who began growing potatoes on the rolling sandy soils here near Stanton in the 1890s, couldn't envision.

Each year, the farm, which operates as Sackett Ranch, has about half of its approximately 4000 hectares devoted to potatoes. The remainder of the area is rotated with grain crops.

The potato crop begins with sourcing the seed stock potatoes, which arrive in mid-February. These whole potatoes are grown in isolated areas of Wisconsin and Michigan which minimises the risk of potential viruses and diseases.

Larry's crews cut and size the potatoes into the chunks that are planted into a seedbed that's been well-worked and mixed to produce a loose fluffy soil, with prior crop residues fully incorporated. As the potato plants emerge and grow, they're tended with multiple cultivations and weekly analyses by crop consultants who recommend timely treatments of crop protectants applied by ground and air.

AT A GLANCE

Larry Sackett counts on a Case IH fleet to produce more than 86,000 tonnes of potatoes annually. His goals include using the tractors for multiple tasks, including switching from flotation tyres to narrow-row tyres on the magnum tractors, maximising the hours they can be used.

Every hectare of Larry's potatoes is watered by one of more than 200 centre pivots; four of Larry's 30 year-round employees are assigned to irrigation duties during the growing season.

A drive for perfection underpins all these steps. Nearly all the potato acreage is grown on contract.

Larry's buyers provide financial incentives for potatoes surpassing their standards that include consistent size and appearance, specific gravity and absence of foreign material.

"Weather conditions throughout the growing season greatly affect potato quality, but there are plenty of variables we can control, including variety selection, fertility and timeliness of planting and harvesting," he says.

Storage management is another factor. Although some potatoes are shipped from the field, Larry stores the majority of the potatoes in his warehouses where temperature and humidity is computer-controlled. Semi-loads of potatoes are shipped nearly daily throughout the year.

Larry says the equipment needed to make all this happen is "beyond belief."

Grain crops to also look after

At peak potato planting and harvest times, he says, they're also working with the wheat, peas, corn and oats that are additional cash crops and rotations.

For example, potato harvest employs four harvesters plus 10 windrowers, 21 trucks and two unloading systems. While that's going on, tillage is underway and the grain crops are being harvested. During peak seasons, some 70 people are employed.

Case IH tractors provide the power. The fleet currently includes four Steiger models, a 500, a 450 and two 435s; 11 Magnum tractors including three 335s with MFD, four 305s, a 225 CVT, two 210s and a 190; and two Maxxum 125s with loaders.

A pair of Axial-Flow combines, a 2577 and a 5088, handle the grain, and some 40 Case IH power units ranging from P70s to PX240s power centre pivots.

Each tractor earns its keep with annual hours averaging over 1000. "We have to use these tractors to the utmost to justify them," Larry explains.

For Larry, that means using these bigger tractors for multiple tasks. When the Magnum tractors are finished with tillage, he removes the wide 710/70R42 rear tyres and 600/65R28 fronts – both duals, he uses for maximum tillage traction on the sandy soils – and switches to tall narrow 380/90R54 duals on the rear and corresponding single narrow tyre on the front.

This lets these tractors handle cultivation, hilling, windrowing and harvesting in the 86 cm potato rows.

"These electronic engines have really helped us on fuel economy for these lower-horsepower tasks," Larry explains. He says that even though they're high-horsepower tractors, features such as the Diesel Saver Auto Productivity Management system enable the tractors to consume only the fuel that's required for the task.

He keeps the tall narrow tyres and rims when he trades tractors, which isn't that often – he likes to see 6000 to 7000 hours on them before trading.

Autoguidance

Autoguidance is a recent addition to Larry's operation. He's using Case IH AFS Autoguidance on his planting tractors, and has been integrating the system to control the steerable rear wheels on his guidance-capable potato planters.

"These planters are heavy when they're loaded with potatoes

and they tend to drift sideways on the hillsides. There's quite a distance between the tractor's front wheels and the rear wheels on the planter. Being able to steer both makes sense," he says.

The management team

Larry runs the operation with a management team that includes his wife, Mary, and his daughter and son-in-law, Michelle and Luke Parr.

As a manufacturing engineer, Luke brings a unique advantage to Sackett Ranch by designing and building specialised equipment, using his computer aided design (CAD) capabilities.

Larry also counts on support from his primary suppliers. For Case IH, he says that not only means unwavering service from his dealer, but also information and support from the Case IH organisation.

For example, he says the Case IH tractor specialist for his area held an on-site training session to help the Sackett Ranch employees understand the productivity features of their newest Magnum tractors. "That he's willing to do that is very important to us," Larry says.

This beneficial business relationship extends to CNH Capital, as well. CNH Capital's promptness and ease of transactions is a special advantage, he explains. "All the way from buying Case IH parts, to leasing, to purchases, working with CNH Capital makes good financial sense," Larry says. "And with them, we can close deals fairly quickly."

Each year, Larry says the major food companies he supplies introduce new grower requirements, often dealing with quality and traceability.

He welcomes the challenge to always work to higher standards. "After all," he says, "it's all about proving that we're producing safe food."



The Sackett Ranch potatoes are stored in multiple on-farm climate controlled warehouses. Temperatures and humidity levels are managed to sustain quality, and vary based on potato variety and shipping date.



Larry Sackett shows bags of potato chips they fry daily to confirm the quality of the potatoes they're shipping. He says they pull 40 potatoes, and take three slices from each one. Desirable high-starch potatoes fry to a golden colour; those with higher sugar take on a darker appearance.

New herbicide makes its long-awaited appearance

VALOR 500WG herbicide from Sumitomo Chemical, the most versatile of the 'protox' inhibitor or Group G herbicides, is scheduled for commercial release in January 2012. Valor will be marketed as a 1.5 kg unit, containing five x 300 gram water soluble sachets. When used as a non-selective herbicide spike, each 300g 'toss and go' sachet treats 10 hectares – making calibration and application simple.

How is Valor 500WG different from other common products in this group – oxyfluorfen and carfentrazone in particular?

All of the oxyfluorfen and carfentrazone products kill weeds by the same mode of action – they are readily absorbed into the leaf tissue where cell membranes are destroyed. There is little or no root absorption, and they do not translocate in susceptible plants. This means coverage, or exposure to the foliage, is necessary for control.

- Valor 500 WG (at rates higher than 30 g/ha) and oxyfluorfen have both foliar contact and activity in soil. Carfentrazone has only minimal soil activity.
- Of these products, oxyfluorfen has the lowest solubility and has been known to co-distillate, which occurs when oxyfluorfen molecules are trapped in water molecules evaporating from the soil surface. Rain or foggy conditions after application may result in the loss or 'lift-off' of active ingredient from the target site to non target areas.
- The efficacy of Valor is hardly reduced by rain, even immediately after its foliar application

What are the benefits of the new herbicide?

Valor's main use is as a spike for glyphosate and paraquat-based herbicides, for the control or burndown of unwanted weeds prior to planting a range of winter broadacre and summer row crops. When added to non-selective herbicides it speeds up the effect and generally improves the degree of weed control achieved. In short, it enhances the herbicidal efficacy of the non-selective partner.

Valor can be used before planting wheat, oats and barley, chick peas, faba beans, field peas, lentils, lupins, maize, mungbeans, sorghum, soybeans, and sunflower. Consult the product label for the list of weeds controlled.

Valor can also be used as summer fallow spray, to improve the efficacy of glyphosate in various situations. Given its superior activity against marshmallow (*Malva parviflora*), this is most likely where most growers will be impressed with Valor.

A common observation from its extensive product development program over multiple seasons, was that Valor 500WG was consistently more robust than competitor products – slightly faster action, fewer weed escapes, less re-growth and better overall result.

Competitively priced at less than \$5 per hectare, Valor 500WG is the product of choice where there is a high degree of reliance for glyphosate to work and when you need to get the most out of your knockdown sprays.

The main points

- As a pre-plant burn down, Valor will give the best result when applied immediately prior to planting. To allow for proper uptake of the chemical, do not sow for at least one hour after application or longer if recommended by the partner herbicide label.

- Always use Valor with an adjuvant. It is compatible with Hasten Spray Adjuvant, Kwickin Spray Adjuvant, Uptake Spraying Oil or LI 700.
- Valor is pre-packed in 10-hectare water soluble sachets. Tear the foil envelope and dump the water soluble sachet in the mixing vessel or spray tank. Do not handle the sachet with wet hands. Proper agitation is required to dissolve the water soluble bags, particularly when adding multiple sachets to a tank under cold conditions.
- Because Valor is highly efficacious against brassica weeds (for example, wild radish, volunteer canola) its safety on canola is marginal. Valor is not recommended prior to sowing canola.
- When using Valor as a burndown spike, it is the non-selective herbicide partner that is doing most of the work. The Group G only serves to enhance its performance. So choose the right rate of non-selective herbicide partner for the weed situation.

A 2012 stocks are limited, interested growers are advised to order early to avoid disappointment.

For more information about Valor visit www.sumitomo-chem.com-au

Milestone for NIR analysers

IN June 2000, the first CropScan 2000G Whole Grain Analyser was launched into the Australian market. In November 2011, the 1000th CropScan was produced.

The CropScan range of Near Infrared Transmission analysers provide a rapid means of measuring protein, moisture and oil in cereals and oil seeds. The CropScan range was originally developed to provide farmers and small, independent grain buyers with NIR analysers that are rugged, transportable and cost effective.

Over the past 11 years the product range has expanded to include the CropScan Loren 1000G On Farm Analyser, the CropScan 1000B Whole Grain Analyser, the CropScan 2000B NIT Analyser, the CropScan 2000H ON Header Analyser and the CropScan 2000S On Silo Analyser.

These analysers are built around a unique diode array spectrometer that is compact, rugged and stable. The diffraction grating used in this spectrometer is made using a holographic projection and photolithography. This procedure has ensured that all CropScan analysers are optically similar. By using a simple transfer algorithm it has been possible to align all spectrometers to a master instrument on which calibrations are developed.

As a result, the ability to transfer calibrations from instrument to instrument is an excellent feature of the CropScan range.

The CropScan range was originally designed for Australian farmers, however approximately 60 per cent of production has been sold overseas. CropScan analysers have been sold into Italy, Japan, China, India, South Africa, Brazil, US, Canada, UK, France, Hungary, Ukraine, Korea, Romania, Belgium and other countries.

For more information on the CropScan range of NIT analysers, please contact Mat Clancy, 612 9771 5444 or mat.clancy@nextinstruments.net



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Simple sowing with triple bins

WESTERN Australian grower, Peter Wheeldon, was impressed by his new Flexi-Coil 5500 air drill and 4350 tow-between, triple-bin air cart. He used the combination to sow 800 hectares of lupins, 700 hectares of canola and 3500 hectares of wheat in the 2011–12 season on his family's 5000-hectare property in Yuna, northeast of Geraldton.

Peter runs four farming properties along with his parents, Les and Kath Wheeldon. Last season was the first time they had used the new Flexi-Coil set up for seeding and Peter said it coped well with their variable soil conditions and high levels of weed residue.

"We sow to about an inch-and-a-half deep on all crops and our soil varies from red clay to white sand," said Peter. "The air drill did a great job of placing the seed right where we wanted it and the crops have come up nicely spaced and are healthy."

Available in 60- and 70-foot widths, the Flexi-Coil 5500 air drill features a patented two-piece wing, with simple, parallel-circuit hydraulics. This design minimises stress on the framework while ensuring depth accuracy. Its exceptional land following flexibility provides precise seed placement. Each wing is attached to a collective allowing each wing/press wheel combination to follow the ground.

Peter said the 5500 air drill's design meant it got through the trash really quickly without too many blockages.

"I also really like its simplicity – it's easy to use and the combination of the 5500 air drill and the high capacity three bin 4350 air cart means we'll no longer have to mix the canola seed in with the fertiliser as we did with our old air cart. With the three bins, we can allocate one to seed, one to urea and one

to DAP, saving time and allowing my father and me to do the seeding on our own."

Large capacity, diverse metering

The 4350 air cart is part of Flexi-Coil's 50 Series air carts that are ideal for growers who need large capacity and diverse metering capabilities or the capability to apply large volumes of seed and fertiliser in a single operation.

The Flexi-Coil three down-draft metering innovations easily accommodate a variety of cropping activities or large air seeders. The air cart features a specially designed agitator bar to prevent bridging for constant density and supply of product to the meter roller. It allows the product to be divided into equal sections – one for each primary line in the distribution system.

Air and product are mixed in a parallel flow for a smooth transition from the meter box to the distribution system.

Peter says the combination of the 5500 air drill and the 4350 air cart will definitely make their lives simpler.

The Wheeldons' 70-foot 5500 air drill was set on 12-inch spacings with 4-inch press wheels and 350-pound trips. They do skiprow sowing to minimise the turning stress on the machine.

"We had a different seeding boot to the one we used in the past on our Flexi-Coil ST820 and it spread the seed out a bit, which would have helped the placement," said Peter.

"We managed to get a great result even though we were still learning how to get the best from the 5500 last season. This coming season will be even faster and easier."

For more information about Flexi-Coil seeding and tillage equipment visit www.flexicoil.com.au



Peter Wheeldon (left) purchased his Flexi-Coil equipment from Purcher International's Gavin Watson. (PHOTO: Farm Weekly)

District Reports...

January–February 2012

The most important thing now is that growers get a well earned holiday and regain the enthusiasm to do it all over again in 2012.

Quenten Knight,
Agronomist, Precision Agronomics Australia
January 14, 2012

Western region



NORTH

Harvest is almost complete with one or two growers to finish over the next week. Generally, 2011 results have been very good and most growers are very happy with their harvest.

Dry conditions have prevailed over most of the region for the last month or so. Late spring rains have summer weeds up and away in most areas and spraying started on most farms as harvest finished. A few farms in the east of our district have had thunderstorms in the past week that have dropped up to 40 mm in small strips.

Spraying for summer weeds is probably the main activity on farms at the moment.

Holidaying, machinery maintenance, fence and obstacle removal, soil testing and planning for the coming season are other jobs on the agenda.

The 2012 season is off to a good start and the hope in our patch is that it will be up there with 2011.

Peter Norris

Agronomy For Profit and Synergy Consulting, Geraldton
January 18, 2012

SOUTH COAST

Seasonal conditions on the South Coast over the past two months have been damp. Most of the region has had between 100 to 250 mm of rain from October to the middle of January.

Whilst this rain has been welcome in terms of building up stored soil moisture levels, it has made harvest drag on longer than most growers would have liked.

In addition to harvest frustrations the summer weeds have been growing at a rapid pace. Most growers have at least completed one full summer weed knockdown and many are now in the process of starting the second knockdown.

Surprisingly, with all the rain over harvest, grain quality has been reasonable with good falling numbers and high protein. But there were some exceptions to this where some growers have delivered large tonnages of feed grain.

Yields have been average to very much below average with the Esperance Port zone receiving approximately 1.5 million tonnes. The average yields have come from the western regions of the port zone and those within 50 km of the coast.

All other areas to the north have had close to their worst season on record particularly around Grass Patch and Salmon Gums.

Southern region



SOUTH AUSTRALIA

Weather

Maximum temperatures for November were 1° to 2°C above average across the state with near average temperatures during December 2011.

High rainfall in the summer and autumn, with late thunder storm activity resulted in the fifth wettest year on record across the state, but the actual growing season rainfall (April to October) was well below average.

Thunderstorm activity in late November and December 2011, brought strong winds and widespread rain. Severe thunderstorms on 17 December 2011, caused flooding and damage to isolated areas across the state.

November 2011 rainfall was generally average to above average, except for Eyre Peninsula where falls were below average.

December 2011 rainfall was average to above average depending on thunderstorm activity.

Crops

Harvest was completed in all but the later districts by the end of December 2011. Grain yields have generally been above average – but some districts particularly the Northern Mallee and northern parts of the Upper North only achieved average yields.

These good yields have been achieved despite well below



Grain yields in SA were generally above average.

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average growing season rainfall. Within districts – and even between individual properties – there was considerable yield variation, due mainly to the amount of soil moisture that had been stored from summer and autumn rains.

Grain quality was generally above average with a high percentage of grain classified into the better quality grades, although there were a few districts with some quality issues.

Quality issues included:

- Black tipping and weather damage of both wheat and barley in some areas.
- Pre-harvest sprouting of some varieties in a number of districts, following heavy rainfall events.
- White grain in both Eyre Peninsula and the Upper North.
- Mould development on field pea grain following damage from frost and hail.
- Weather damage of many bean crops, resulting in down-grading and rejection of loads.

Annual ryegrass populations were high following seed build-up in 2010, reducing crop yields and contaminating grain samples.

Snail populations have built-up in a number of districts across the state and caused harvesting issues and contaminated grain samples.

Pulse diseases were generally at low levels, due to low disease pressure and good fungicide management.

Canola generally performed well across the state with average to above average yields and high oil levels.

Mouse numbers have fallen, but there is concern that they could rapidly build-up again.

Pastures

The quality of annual pastures has deteriorated but summer rains have provided some green feed. There is currently adequate feed from stubbles, and livestock across the state are in good condition.

Michael Wurst
Farming Systems Consultant, Rural Solutions SA
January 12, 2012

WIMMERA

The summer of 2011–12 has been a vastly different scenario to that of 12 months ago.

Rainfall has been sporadic – more in tune with a 'normal' Wimmera summer. As a result, summer weeds are not as prolific and the urgency to spray every paddock is not there at the time of writing.

Following a dry growing season in 2011 it is expected that most soil profiles will be dry to half a metre or more requiring a good moisture top-up to set in train another good season.

If we do get some good rainfall, we can expect increased plantings of canola and pulses in 2012 as these crops are showing favourable gross margins. Fertiliser use in 2012 is also likely to increase to replace nutrients removed by two big crops and last year's flooding rains.

Crop establishment will be difficult for those not prepared to burn stubbles in 2012. Heavy cereal crops have left a thick

blanket of straw which will be a problem for some tined air seeders.

Some growers had success with mounted cutting coulters on their planter bars last year. This was partly in response to some weed issues, but it was also very successful in cutting the straw to allow a path for the sowing tyne following behind. Coulters could be a winner again in 2012.

Every year a few more disc seeders come into the Wimmera – and this trend seems set to continue. While some machines cause problems in the use of pre-emergent herbicides, the bonus is in being able to get over many acres in quick time.

As farm sizes continue to increase, the need to sow quickly is becoming paramount.

Mike Laidlaw
Harberger Farm Supplies, Donald
January 17, 2012

MURRAY VALLEY RICE REPORT

Ducks were the main topic of interest for Murray Valley rice growers up until mid December – now attention has moved to the alarming frequency of cold night temperatures.

Ducks caused major crop damage in some locations, particularly in crops close to watercourses and harbourage areas. Some growers have re-sown crops multiple times only to be



These photos were taken from a light aircraft on December 23, 2011. The rice crop should be thick and green at this stage of the season but all the 'bare water' is due to duck damage. (PHOTOS: John Fowler)

eaten out again. There has been several thousand hectares of crop abandoned due to duck damage.

These areas will mostly be sown to early winter crops in autumn – either canola or wheat.

Growers were still chasing ducks off crops in early December, which is both unusual and frustrating. One local grower who has an aversion to shooting actually bought his first shot-gun last spring. Shooting was so common that ammunition suppliers in Deniliquin were completely sold out of shot-gun shells prior to Christmas.

By mid December, duck numbers tended to decline and growers were able to focus on other issues.

Drydown trials

There has been an increased number of growers trialling mid-season drydown of crops, especially in the Denibootea district.

Some of the crops were very stressed before water could be re-introduced. This practice has led to significant yield increases in previous years, probably due to the very hot weather at establishment in 2009 and large amounts of incorporated organic matter in 2010.

Neither of these conditions occurred this season, so it will be interesting to see if yield increases still occur.

Weed control has mostly been satisfactory this season. The one exception is the high incidence of Dirty Dora in top bays. This is probably due to water being re-introduced too soon after herbicide treatment.

A large proportion of the crop reached panicle initiation before

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New Year. This may be due to temperatures from mid October to early December being above average. Most growers find it hard to believe it was a relatively warm start to the season, but the data indicates it clearly was.


December temperatures were below average, which did slow crop progress down a little. The ideal time for crops to reach PI is the first week of January.

There has been a large increase in the number of crops being sampled at PI for nutrient uptake and to get some clearer guidance on nitrogen topdressing. Most growers have managed to achieve nitrogen uptake at PI in the acceptable range of 100 to 150 kg N per hectare and many were in the desired range of between 110 and 130 kg N.

The big question now is what will night temperatures be at young microspore? About half the nights in the first half of January had minimum temperatures below 15°C – some were down around 10° and even getting as low as 6°.

If this trend continues it will impact district yields far more than the ducks. All crops will be affected, even the more cold tolerant Sherpa crops.

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

<i>Brought to you in association with</i>  JOHN DEERE	25yr Annual Average (mm)		2012 rainfall to date (mm)		Summer 25yr Annual Average (mm) 2011–12 to date		Autumn 25yr Annual Average (mm) 2011		Winter 25yr Annual Average (mm) 2011		Spring 25yr Annual Average (mm) 2011	
Emerald Qld	559		19		247	143	114	315	66	21	120	81
Toowoomba Qld	670		22		265	148	140	233	86	91	176	186
Roma Qld	594		14		238	243	133	339	75	38	139	143
Goondiwindi Qld	630		89		242	268	140	166	101	82	141	251
Narrabri NSW	661		78		235	126	130	107	132	68	163	329
Gunnedah NSW	682		0		232	103	132	110	128	44	184	321
Dubbo NSW	621		51		196	126	136	137	129	79	157	239
West Wyalong NSW	450		0		112	34	92	187	118	76	127	196
Wagga Wagga NSW	547		1		129	68	117	116	154	108	146	211
Swan Hill Vic	335		13		74	45	70	74	94	64	98	91
Bendigo Vic	543		8		114	43	112	105	176	147	142	146
Horsham Vic	385		8		86	40	77	62	133	101	110	95
Lake Bolac Vic	562		13		129	37	104	121	160	102	154	112
Murray Bridge SA	367		11		65	70	75	132	124	96	102	86
Kadina SA	344		18		56	68	78	148	117	102	91	62
Cummins SA	391		7		50	36	84	94	173	116	83	80
Esperance WA	613		30		76	92	141	117	254	230	140	186
Wagin WA	409		4		43	109	95	49	180	183	86	167
Northam WA	405		1		41	17	87	63	195	225	81	129
Mingenew WA	368		7		31	12	93	122	181	205	63	88
Moora WA	393		37		40	53	94	126	187	155	71	102
Mullewa WA	330		0		50	1	96	72	138	174	46	60

Last rainfall reading January 19, 2012.

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The cool nights caused many growers to reconsider the rates of urea they top dressed with at Pl. Many elected to use the 'shallow water' recommendation rate on the NIR Tissues Test report even if they could attain deep water on their crops.

The cold temperatures have given greater impetus for growers to get deep water on crops before microspore. Access around crops is currently difficult as the deep water finds all the cracks and weak spots in the banks.

If cold night temperatures do continue, the problems and effort associated with maintaining deep water will be worth while.

John Fowler
Deniliquin District Agronomist
January 13, 2012

GRIFFITH RICE REPORT

The main issues this season impacting on rice crop establishment and growth – to varying degrees – were the cooler early October temperatures, wind, water management and water supply issues.

For rice grown on the margins of the main rice area or near creeks or swamps, duck damage has been a major issue, with a number of re-sows occurring. Although given all these issues, for most rice growers, rice crop establishment was generally very good.

Early/mid December crops began to show mid season yellows with some crops being topdressed early as a result. Most crops reached the panicle initiation (PI) topdressing stage earlier than expected (between Christmas and New Year), given that the average daily temperatures were warmer than usual.

Temperatures during early microspore will put some of these crops to the test due to the cool spell from around January 10.

Deep water during this sensitive stage would be the key in protecting the developing panicle from the impacts of cold.

Rachael Whitworth
Extension Agronomist, NSW DPI, Griffith
January 11, 2012

Northern region



DARLING DOWNS

Summer crops

There has been a strong planting of early summer crops, and maize is being cut for silage. Sorghum is filling grain and starting to ripen around Dalby, spring mungbeans are in pod-fill and close to dessication, sunflowers are flowering and cotton is growing well and enjoying the warmer sunny weather.

Subsoil moisture is good and irrigated crops have just had a full watering from the good storages throughout the Downs.

Yield potential is good at this stage with crops growing strongly on the subsoil moisture and the above average rain earlier in the season. The grain crops look very strong, whilst cotton and pulses look good, despite having some establishment issues.

There is a late summer planting underway of maize, some sorghum, sunflowers, soybeans and mungbeans – and these crops would appreciate a rain to get secondary roots going, bring dry seed up and generally grow strongly.

It has been an unusually long period since the last significant rainfall in late November/early December.

Insect pressure was moderate early but has been exceptionally low over the Christmas period and remains light.

Winter crops

The winter crop harvest was good in that growers managed to harvest their crops this time as opposed to the 2010 harvest disaster with the rain damage. But in many cases this season the quality has been down, reducing prices.

Charlton's

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CENTRAL QUEENSLAND

Rainfall and temperatures

Even though the weather experts predicted a very wet 2011–12 summer for CQ – with above average rainfall expected to be the norm – so far rainfall this summer has been stop/go at best.

Rainfall for November 2011 was below average for most districts with only Springsure and Theodore well above average.

During December 2011 more areas were wetter, particularly Emerald and Springsure but again the rainfall was patchy and paddock-wide rather than district-wide.

Prior to Christmas some people were nervous about what the



Andrew Erbacher checking plant establishment in a sorghum crop at Andrew Bates' 'Bendee', near Gindie. Low establishment in many sorghum crops was the result of extremely high temperatures as the crop was emerging.

Yields of cereals were some of the best seen for many years – ranging from four to seven tonnes per hectare in wheat and barley. The drawback was mainly low protein as few farmers fertilised for such high yields.

There was some black point and disease affecting quality, such as crown rot and botryosphaeria.

Chickpea performance was solid rather than outstanding but quality was good.

Many growers are storing a percentage of their production in the hope of better prices. There has recently been an increasing flow of grain moving off-farm.

Hugh Reardon-Smith
Agronomist, Landmark Pittsworth
January 6, 2012

SOUTH BURNETT

Key issues

- Need rain.
- Increase in peanut plantings.

We need rain. It is hard to comprehend that this time last year we had some of the most devastating floods for over 100 years.

About 70 per cent of the area is planted. Ideally, the only crops left to plant would be mungbeans and navy beans. But if growers had received earlier rain we would have had more peanuts, corn, sorghum and soybeans planted.

The reason for the increased interest in peanuts is due to a price increase, whereas most other commodities have gone down in price.

A world shortage of peanuts has resulted from lower than expected production in North and South America. How long this increased demand for Australian peanuts will last is the 64 dollar question.

This will be the largest peanut planting in the South Burnett for a number of years.

But not all paddocks that were planned for peanuts will be planted to them. By the time we get some rain and farmers can get on the field to plant peanuts it will be too late. Cool weather in autumn and the risk of frost means that planting peanuts later than early January is rather risky for most growers.

Early development of the peanut leaf disease, net blotch, is of concern. There have been relatively few infective periods yet it is easy to find net blotch in the early peanut crops. A good preventative fungicide program will be needed if the season turns wet – like it is supposed to.

Other crops

We have also had increased interest in soybeans, but this has waned as the season got later and growers are now looking at the shorter season navy and mung beans. The navy bean price is holding around \$1000 per tonne, while mung beans have dropped significantly from the high prices of the past couple of years.

The corn plant is far from complete, but growers will continue to plant over the next couple of weeks if we get decent rain.

For the first time for many years, irrigators along Barambah Creek have full irrigation allocations from Bjelke-Petersen Dam. This has resulted in the largest cotton plant for years.

Hoping for a good summer crop to help growers recover from previous below-average seasons.

Ian Crosthwaite
BGA AgriServices, Kingaroy
January 13, 2012

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January–February 2012

skies might deliver especially those affected by flooding during the previous summer. Most farmers received enough rain in December to grow grass weeds but not enough to replenish dry soil profiles.

The New Year has started hot and dry.

Sorghum

Very little sorghum or mungbeans were planted during spring and most of these crops have done it tough during the January 2012 heatwave. Yields will mostly be low.

Without good soaking rain in the next week or so, the area planted to summer crop in CQ will be well down on what is normally planted. Probably only 40 per cent of a normal sorghum planting is in the ground at present.

The planting window for sorghum will close in the Dawson and Callide Valleys in a couple of weeks, and progressively later as you travel north, but a couple of weeks after that at Kilcummin.

Ergot can be a significant issue for late planted crops especially in years with cooler autumns.

ANSWER TO IAN'S MYSTERY TRACTOR QUIZ

The lightweight small acreage tractor is a 1948 Newman WD2, powered by a 10 h.p. Coventry Victor single cyl. diesel engine with a capacity of 567 cc.

Newman tractors attracted few followers in Australia. They were an odd-ball machine that most farmers felt they could do without. During the Australian Tractor Test No.136 the manufacturers claim of 10 h.p. could not be sustained.

Despite selecting a further three identical models at random, the maximum power that could be achieved was merely 7.5 h.p. (Photo IMJ courtesy J and T Brennan)



Other summer crops

Lower prices, a tougher market and lack of planting rain have combined to reduce the area planted to mungbeans thus far.

Only farmers with a contract are likely to plant maize in the current market.

In previous years, late summer rain often saw a big increase in the area planted to sunflowers instead of sorghum. Even if we get late summer rain this year the current price for mono sunflowers, and the cost of transport to the crushing plant at Newcastle, will be significant restraints to the area planted despite a recent marketing push by the sunflower industry.

Winter crop

Late rain could mean an increased area being planted to winter crop, particularly chickpeas. Last season the area planted to chickpeas was well down mainly as a result of low availability of CQ grown seed.

Weeds and other pests

In early summer most farmers thought they were on top of their fallow grass weeds, normally feather top Rhodes grass on scrub soils and sweet summer grass on downs soil. A few weeks of wet weather during December were enough for many paddocks to again be covered in weeds.

An increased use of metolachlor has occurred – either with or without atrazine – to add a residual herbicide to the management system.

A few farmers have reported good success with the double knock technique – a robust rate of glyphosate followed 7 to 14 days later with paraquat contact herbicide. But this system is not bulletproof as it appears if you get rain and the plant starts to recover before the double knock, then weed control can be poor.

There are localised hot spots of rat damage to dryland summer crops, including the Gindie district. This problem has been ongoing for months.

Maurie Conway
Principal Technical Officer
Grower Solutions for Central Queensland
Agri-Science, Emerald, Qld
January 18, 2012

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