Pay less tax – buy and be stimulated

No till, no sheep and ‘knowledge’

Calming farming stress

Pay less tax – buy and be stimulated
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FRONT COVER

The WA based farming system ‘No Till, No Sheep and Knowledge’ has a break even rainfall on light soils of around 150 mm per year. It’s a system with great promise for our (vast) moisture challenged cropping areas. See article page 36.

(COVER PHOTO: Peter Norris)
Editorial... Lloyd O’Connell

After a few days considering the recently tabled federal budget, there’s still something I’m missing. Some may cruelly suggest it’s a life I’m missing if any more than five minutes is spent pondering over budget pronouncements. But the bit I really don’t get is why a government would go well and truly out of its way to bite the hands that literally feed the Australian economy.

Our major primary industries of agriculture and mining are the economic drivers of our domestic and export sectors – not to mention the very sectors that are most able to steer us safely through the current global financial and economic mess we’re in. But instead of helping mining and agriculture, the government’s slashing of rural research and development support, and its insistence that an emissions trading scheme must be introduced, does nothing but impede the nation’s ability to recover and grow. Both of these ill-considered policy directions would seem to fly directly in the face of the facts.

Amidst a very choppy sea of international market competitors propped up by government subsidies, and a highly variable local climate, most Australian farmers have survived and prospered thanks largely to on-farm, and continual, productivity gains. And these gains have come from very clever, and very targeted agricultural R&D.

But instead of doing as much as possible to help these productivity gains along, the budget takes the axe to our proven and unique system of R&D support. One high profile chop is the decision to shut down – contrary to Productivity Commission advice – Land & Water Australia. Its chair, Ms Bobbie Brazil, recently pointed out the folly of this decision.

“Australia’s system of joint government and industry investment in rural innovation has been envied throughout the OECD ... It is a uniquely Australian solution to the market failure inherent in a sector ... that lacks the economy of scale to independently support its own R&D. Abolition of Land & Water Australia placed the long-term productive sustainability of Australia’s land and water resources at risk.”

Ill-considered decisions like the abolition of Land & Water Australia and massive reductions in federal and state government spending on R&D in many other areas, will mean the closing down of hundreds of promising research projects.

These cuts to rural R&D and plans to impose a carbon emissions trading scheme which appears to be “an ineffectual response to speculative global warming” (see article page 40) do nothing to help our primary industries. Mining and farming are the sectors which not only built the nation’s now rapidly diminishing wealth, they are the sectors most capable of replenishing the national coffers. But the government must play its part.

In this issue...

Volatile may help calm farming stress

Unlike most animals, plants can’t get up and move away when there is something unpleasant in their immediate environment. As a result, they are subjected to a barrage of stressful conditions. They must therefore have the capacity to cope with relatively large changes in their environmental conditions.

See article .................................. Page 12

Be patriotic and pay less tax!

Over past months the federal government has announced a number of measures to help stimulate the Australian economy in the face of global recession. One measure of particular value to farming businesses – but one that has not received a lot of attention – is a proposed 10, 30 or 50 per cent investment tax break.

See article .................................. Page 28

The no till, no sheep and ‘knowledge’ farming system

No till, no sheep and ‘knowledge’ is the name I have given to our emerging farming system in Western Australia’s northern wheatbelt. It is the system that is used by almost all of the farm businesses that employ my agronomy services. This developing farming system has a break-even rainfall on sand soils of around 150 mm – and on heavier soils around 175 mm. It is a vast improvement on production systems even those from the recent past.

See article .................................. Page 36

A tractor driver’s lot – 1949 style

The day to day adversaries facing modern farmers are little changed from those experienced by their grandfathers 60 years ago. The fickle patterns of the weather, the illogical gyrations of commodity prices, the inevitable escalations of input costs, the inconsistencies and often absurdities of government policies – these tribulations have been present to worry farmers for as far back as anyone can remember.

See article .................................. Page 36

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Safflower originates from the eastern Mediterranean and is adapted to semi-arid areas receiving winter and spring rainfall with a dry atmosphere during flowering and maturation. Although safflower has been grown in West Asia and North Africa for a long time, interest in safflower as an edible oil is much more recent. It is possible to profitably produce safflower in Mediterranean climates and with the rainfall experienced in countries such as Lebanon. And a recent study showed that growing safflower brings in higher income than barley, lentil and chickpea in this region.

**Relevant cropping systems research**

Conventional tillage (CT) which involves ploughing followed by cultivation has been practised for centuries. But CT leads to soil erosion and loss of organic matter. As a remedy, systems that include minimum tillage (MT) and no tillage (NT) have been recently and widely accepted by farmers in many developed countries, particularly in Australia. But little research has been conducted on conservation tillage in developing countries. And as little tillage research with safflower has been conducted in either developed or developing countries, the results of this are of interest to potential and existing growers in Australia.

As part of a NT system, fertiliser use and crop rotation should be considered. Nitrogen (N) is a costly input and excessive application will lead to pollution of ground water with nitrate. Safflower generally has deeper roots than wheat or other small grains, so it may use nutrients and moisture that are unavailable to the cereals. No study on the interaction of tillage with N supply, and rotation on safflower performance as no previous research has been reported.

**Site and climate**

The rainfed field experiments were conducted in 2005–06 and 2006–07 at the Agricultural Research and Educational Centre of the American University of Beirut in the semi-arid northern Bekaa Valley of Lebanon, which has a cool Mediterranean climate.

The long-term annual precipitation of the site is 513 mm, 58 per cent of which falls in December, January and February. Rainfall was 480 mm for 2005–06, but was only 432 mm for 2006–07. The long-term mean annual temperature is 13.9°C, with a mean monthly maximum and minimum of 31.7°C in July and –4.8°C in February, respectively. The frost-free period lasts from mid-April to mid-November. The soil is an alkaline (pH 8.0), clayey, vertic xerochrept formed from fine textured alluvium derived from limestone.

**How the trial was done**

There were two factors with four replications in both experiments. The first factor was tillage with three treatments: Conventional tillage; Minimum tillage; and, No tillage.

CT consisted of one ploughing in early October by disc, followed by one disc-cultivation in late October and one grading. In MT, there was one disc-cultivation in late October. The experiment was laid out in a strip-plot design.

| TABLE 1: Mean grain yield and three other agronomic characters of safflower under the three tillage practices |
|----------------------------------|-------------------------------------------------|-----------------|-----------------|-----------------|
| Tillage | Grain yield (kg/ha) | Straw yield (kg/ha) | Harvest index (%) | Days to flowering (from April 1) |
| CT | 2290 | 8850 | 19.7 | 70 |
| MT | 1780 | 7190 | 19.2 | 70 |
| NT | 2430 | 9510 | 19.3 | 71 |
| Mean | 2160 | 8520 | 19.4 | 70 |
| L.s.d. | 569 | 1660 | ns | ns |

Crop rotation has a substantial influence on sustainability of any farming systems. It is generally accepted that legumes in rotation with cereals are beneficial. But the effect of previous crops on safflower performance is not known. Based on experience with other crops, it is expected that continuous safflower will be unsustainable.

So the objective of this study was to evaluate conservation tillage, the interaction of tillage with N supply, and rotation on safflower performance as no previous research has been reported.
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The second factor was nitrogen: 0 and 40 kg N per hectare as ammonium sulphate broadcast on December 16.

In 2006–07, the second factor was rotation: safflower grown after a previous crop of barley, chickpea or safflower. The 2005–06 experiment was conducted on a field from which a previous conventionally tilled crop of oat was harvested. The averaged content of soil mineral N in the 0–40 cm layer was 5.1 mg per kg.

The 2006–07 experiment was carried out on the exact site that the 2005–06 experiment was conducted, with the tillage treatments following the same randomisation. Thus the NT treatment was under zero tillage for the second year.

Seeds were sown with an experimental no-till drill in mid-November. Weeds and insect pests were controlled.

**Safflower compatibility with no-tillage**

This study showed that safflower is suitable for growing under NT as CT did not give higher yield than NT and there was no tillage by year interaction (Table 1). This result was different from those reported on barley and chickpea conducted at the same site, in which inconsistent performance of NT versus CT was obtained.

The absence of tillage by N interaction on grain yield suggests that the N recommends under CT are applicable in NT as well.

Results from this study also confirms the earlier findings that safflower has no yield response to N application after fertilised crops (Table 2).

The reason for no response to N application can be explained by the fact that safflower has deeper roots which can take up nutrients and moisture that are unavailable to the cereals and other crops with shorter roots.

The finding that N application led to higher dry matter yield at flowering – but a lower harvest index at maturity – strongly suggested that N fertilisation led to a high dry matter production which in turn led to earlier depletion of soil moisture and consequently lower harvest index.

**Previous crop effect?**

In this study, previous crops had no effect on safflower performance though safflower after safflower led to less early growth vigour right after emergence.

This finding was in contrast to the results of barley and chickpea collected in the same site, in which barley yielded less after a crop of barley than after chickpea or safflower, and chickpea gave the lowest yield after a crop of chickpea.

It is speculated that as the deep-rooted safflower is able to take up water and nutrient from deeper soil layers, its seed yield is less dependent on early vegetative growth.

Safflower also has a much longer growing period than barley and chickpea, meaning poorer early growth may be compensated in the later part of the life cycle. Nevertheless, it is prudent not to take risks by following a proper rotation.

**TO SUM UP**

In summary, as previous crops had no differential effect on safflower performance – and because safflower can increase the seed yield of the following cereal crops – our research suggests that cereal/safflower is a viable rotation in cool Mediterranean climates.

**Acknowledgements:** Research was conducted under the financial support of the Lebanese National Council for Scientific Research and the University Research Board of the American University of Beirut. Thanks also go to Diana Abu-Eid and Nicolas Haddad for technical assistance.

Copies of the proceedings from the 7th International Safflower Conference are available for purchase from www.australianoilseeds.com

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**TABLE 2: Grain yield and three other agronomic characters under the two N treatments in 2005–06**

<table>
<thead>
<tr>
<th>N treatment</th>
<th>Grain yield (kg/ha)</th>
<th>Straw yield (kg/ha)</th>
<th>Harvest index (%)</th>
<th>Days to flowering (from April 1)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 kg/ha</td>
<td>3070</td>
<td>9650</td>
<td>24</td>
<td>67</td>
</tr>
<tr>
<td>40 kg/ha</td>
<td>2820</td>
<td>10970</td>
<td>20</td>
<td>65</td>
</tr>
<tr>
<td>Mean</td>
<td>2950</td>
<td>10310</td>
<td>22</td>
<td>66</td>
</tr>
<tr>
<td>L.s.d.</td>
<td>ns</td>
<td>ns</td>
<td>2.6</td>
<td>1.1</td>
</tr>
</tbody>
</table>

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Neill Wiseman’s father began farming this southern NSW property around 1960. Neill took over farming in 1975. Neill and Gina started to convert to organic agriculture in 1998, and over a five year period, converted the entire farm to organic to meet the demands of niche markets. But they now are keen to remain organic growers for a range of reasons.

**Neill and Gina’s comments…**

**Why grow soybeans?**

We’ve been growing soybeans since the 1980s, originally conventionally. We decided we could grow them organically very basically, after we worked out what we had to do to make it happen. We started with organic onions as a winter crop.

**Negative aspects of growing soybeans**

I don’t know if there is anything negative about them. With the newer varieties, we can get them harvested usually before the break of the season. The soybeans work quite well in our organic situation.

**Sowing system**

We have a John Deere Max Emerge planter. It is a disc opening precision planter with decent closing wheels (press wheels). If it’s too wet, we don’t put too much pressure on the wheel. We sow into moisture and don’t water up.

**FARMERS**

Neill and Gina Wiseman, organic soybean growers

**LOCATION**

Coleambally, southern NSW.

**ENTERPRISES**

Onions, soybeans, pumpkins, about 200 prime lambs – all certified organic.

**PROPERTY SIZE**

400 hectares.

**AVERAGE ANNUAL RAINFALL**

300 mm.

**SOIL TYPE**

Very variable, heavy grey to red cracking clay.

**SOIL pH**

Neutral, following 10–12 years liming.

We aim to pre-irrigate about two weeks before sowing so we don’t lose moisture. Beds are 1.83 m wide (6ft) with three rows of soybeans per bed (45 cm spacing on the bed). We aim to sow soybeans mid November, and to establish 35 to 40 plants per m² (350–400,000 plants per hectare).

**Harvesting equipment**

We use an International header with a front fitted with a floating cutter bar. In the past we used a contractor, but with our clean down requirements before harvesting, it made it very difficult. It could take eight hours to clean down a harvester beforehand.

**Paddock preparation**

Before the drought, a green manure crop was sown the previous autumn, including a mix of vetch, oats, faba beans and other crops as green manure material. The crop would be ploughed in during August, usually with a rotary hoe.

Then we prepare the beds and the seedbed is ready to pre-irrigate in late October or early November.

**Varieties**

We predominantly grow Djakal. In the past we have grown Snowy, Bowyer and Currina, which is suited to an earlier planting time.

**Crop nutrition**

We do a soil test before sowing. We use rock phosphate and other nutrient sprays, such as ‘Seed and Soil’ which provides food for the biology (microbes) we add. We also use a product called ‘Balance and Grow’ which contains the living organisms as well as food for them.

The rates and products we use depend on the year and crop. The green manure also helps fire the soil up. Seed is treated with a legume inoculant and organic starter nutrients.

**Weed control**

Pre-irrigation allows for germination of weeds which are harrowed before planting. After sowing weeds are controlled by inter-row cultivation.

**Pest management**

We manage pests with good husbandry, good watering and keeping the cultivation right and trying not to stress the plants. We have concentrated on looking after the health of the plant, and find that when we do that we have very few pest problems.

**Disease management**

With soybeans, we haven’t had any major issues. We’ve found them pretty good regarding diseases. We try to always use clean, fresh seed. Our country has been lasered so we don’t get waterlogging (which leads to disease like phytophthora).

**Cost of production**

The organic soybeans cost more than a conventional crop to grow, because we in-

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This case study is part of the Better Oilseeds project addressing the urgent and critical need to lift the productivity of oilseed crops within Australia, specifically canola, sunflower and soybean, to ensure critical mass and consistency of production and to improve the quality of grain produced.
clude half of the costs of the green manure crop into the costs for soybeans. This can add about $150 per hectare (half of the full cost) to the variable costs.

Water is $300 per megalitre at the moment. And if the soil is very dry it needs 2.0 to 2.5 ML per hectare (equivalent of 8–10 inches rain) to wet it (to field capacity).

A fully irrigated crop takes 7–8 ML per hectare, so you need to look at the opportunity costs. If you can buy water at $100 per ML, it’s feasible.

**Economic benefit from growing soybeans**

In past years, the price of conventional soybeans has ranged from $500–$600 per tonne, while organic soybeans were in the vicinity of $800–$900 per tonne.

The benefits also include high quality sheep feed following a soybean crop, due to beans left behind after harvest.

Some nitrogen is also added for the following crop. Although the amount is not massive, it can add up to be quite reasonable. For example, two soybean crops leave enough N for an organic crop of linseed.

**How do you ensure high quality soybeans?**

By using good husbandry.

Vitasoy have been very happy with the quality of our beans. We’ve provided a pretty good, clean product. The proteins are fairly good. If we get the nutrition right, it usually keeps the insect pressure down.

We also monitor our water usage as irrigation management of soybeans can increase yields and grain size. It gives good information about refill points and whether we are overwatering, and the information goes straight onto our computer.

**Soybeans compared to other crops**

Organically I see them as an advantage as they produce their own nitrogen.

**Crop yield**

The last crop we grew yielded more than 3.5 tonnes per hectare, which was more than the district average. Most of the grain is usually sold to Vitasoy but some finds its way to smaller niche markets.
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Unlike most animals, plants can’t get up and move away when there’s something unpleasant in their immediate environment. As a result, they are subjected to a barrage of stressful conditions. They must therefore have the capacity to cope with relatively large changes in their environmental conditions.

The source of the stress might be:
- Biotic – such as insect pests, bacteria, viruses and so on; or,
- Abiotic which includes extremes of temperature, drought, flooding, high light, soil salinity and air pollution, to name a few.

In Australia, we have perhaps more than our fair share of abiotic stresses, and it is predicted that the conditions which promote these stresses will get worse in the coming years. Abiotic stress results in decreased growth rates, poor yield, reduced reproduction and even death.

Natural defense mechanisms

Fortunately, plants have developed a complex network of defense mechanisms to protect themselves against stresses. One of these mechanisms is production of compounds called reactive oxygen species (ROS).

As the name suggests, these compounds are highly reactive; they contain oxygen and include compounds such as hydrogen peroxide, superoxide, singlet oxygen and hydroxyl radicals. These compounds are always present in plants and play an important role in plant biochemistry and physiology, particularly in photosynthesis.

Under stress conditions, they act as signaling molecules, initiating signal cascades to warn the plant that it is in danger. These signal cascades elicit a variety of responses, including activating genes which produce defense compounds. But ROS production is a double-edged sword – ROS can also cause a lot of damage if accumulation is not tightly controlled.

When the delicate balance is upset, runaway ROS accumulation causes large scale cell death and tissue necrosis. This is clearly exemplified by responses to some biotic attacks – for example, fungal and bacterial leaf sport diseases.

In these cases, the pathogens prefer to feed on dead tissues, so the accumulation of ROS is encouraged by the pathogen. In some other cases, the ROS buildup and resulting cell death is a strategy by the plant to kill infected cells and stop the spread of pathogens which require living cells to survive, such as viruses.

This is called a hypersensitive response, and is a specialised defense mechanism used by a resistant cultivar.

Unintended hypersensitive response can also be initiated by some abiotic stresses, for example, air pollution from ozone.

When plants suffer high light stress, they accumulate lots of ROS at photosynthetic membranes; in extreme cases, this causes photobleaching of the chlorophyll and tissue death. Under temperature stress, plant membranes undergo oxidation, which also results in production of reactive oxygen species (lipid peroxides and hydroperoxides).
In fact, many (and possibly all) abiotic stress conditions result in the accumulation or reactive oxygen species. When stresses are combined, for example, high light + high temperature, very large amounts of ROS can accumulate.

**Volatile compounds**

It has been known for many years that plants produce volatile compounds. Some of these are very well known as scents. Examples are the monoterpenes limonene and pinene, which are made by lemons and pines trees, respectively. Many of these compounds are produced via the isoprenoid pathways, and are known as ‘volatile isoprenoids’.

Of all the volatiles, one – isoprene – is produced in by far the largest proportion (about 50 per cent of total volatiles). There is a huge variety of other volatile isoprenoids, and new ones are constantly being identified.

The roles of volatiles in biotic interactions, for example, as insect attractants and repellents, have been well-documented. But recent research has suggested that volatile isoprenoids are also involved in abiotic stress responses. For example, isoprene has been shown to provide protection from high light and temperature stress and ozone pollution, and monoterpenes also protect against heat and high light.

**How plants are protected**

We have developed a theory to describe how these volatile isoprenoids protect plants.

It appears that the volatile compounds affect the buildup of ROS, and supply an extra control level to stop runaway accumulation. Since most abiotic stress conditions result in production of ROS, this mechanism allows for the varied collection of protective effects afforded by volatile isoprenoids.

In Australia, our native plant species produce a huge variety of volatiles – think of the smells of eucalyptus and maleleuca. Eucalyptus species can also produce very large amounts of isoprene. These volatiles react with other gases in the atmosphere in many complex ways. Particles called ‘secondary organic aerosols’ are commonly produced from these...
reactions – Fritz Wendt originally identified these particles as the source of the famous ‘blue hazes’ that hover over many forests in the world.

These hazes have lent their names to many places, including the Blue Mountains in NSW and the Smoky Mountains in southeastern US.

It is possible that the relatively high production of volatile isoprenoid compounds in Australian species contributes to the relative ability to withstand stressful conditions.

**Volatile and crops**

What does this mean for agricultural crops?

For a start, a better understanding of how plants react to abiotic stresses will help us to predict the effect of climate change on different plant species. Some plants produce these volatile compounds others don’t, and it is reasonable to assume that various species of plants will respond differently to climate change depending on whether or not they produce these volatiles.

This also applies to non-crop species. Knowing which species produce volatiles, which volatiles they produce, and how those volatiles protect the plant will be important for these predictions.

Secondly, we can also use this knowledge to help us to produce better stress-resistant crop species in the future. This may be by classical breeding or by targeted genetic modification.

This article is based on research conducted and published by a team of scientists working at Essex and Lancaster Universities in England. Dr Claudia Vickers has returned to Australian and is continuing this area of research at the Australian Institute for Bioengineering and Nanotechnology at The University of Queensland.

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Many temperate forest species, such as these poplar trees, produce large amounts of isoprene from leaves. Isoprene emission is temperature-sensitive, and is highest in the warm summer months. (Photo Claudia Vickers)

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Under normal growth conditions, tobacco plants that have been genetically modified to produce isoprene (on the left) look the same as the control plants which do not emit isoprene conditions (on the right). (Photo Claudia Vickers)
Increasing demands are being made of Australia’s agricultural landscapes and there are concerns that they may have reached a ‘tipping point’. Farmers, scientists and conservationists are all now looking at ways that these landscapes can be made more sustainable by harnessing the ecosystem services, such as pest control and pollination, that native vegetation can offer. The emphasis in considering these issues is at the landscape scale and not the farm or field scale. So all members of rural communities and other interest groups need to be involved in any solutions.

Since the first plantings by European settlers in 1788, the area being cropped in Australia has expanded to more than 25 million hectares and most of this is concentrated in areas with favourable rainfall. As a consequence, clearing and planting has dramatically changed these landscapes. Native vegetation has all but disappeared in some places, cropping areas that now favour plague locusts and other pests are extensive and there is widespread use of pesticides. Added to this is an ever increasing area where crops are grown year-round, thus providing unbroken access to host plants for major insect pests such as Helicoverpa moths.

The end result is a rural landscape broken up into natural, semi-natural and highly modified patches of various sizes and degrees of isolation. Added to that is a reduction in the number of plant species in various habitats and the development of cropping areas that favour pests, discourage natural enemies and pollinators and threaten biodiversity.

A tipping point

In some cases, the cumulative effect of all these activities results in an abrupt change in the ecosystem. That is, the system reaches a ‘tipping point’ with a consequent deterioration in ecosystem services such as pest suppression and pollination.

For example, when only two or three different crops are grown in an area and all of these are attacked by the same pests, there may be a sudden, sustained increase in pest numbers.
With these problems comes a growing awareness that insect pests are not constrained by crop boundaries and so managing them can’t be either. It is also probable that the huge expanses of crops in some regions are more susceptible to pests than crops grown in isolated locations. The extensive production areas, which may themselves provide more favourable habitats for pests, also lack the non-crop habitats which probably play a crucial role in maintaining populations of natural enemies in agricultural landscapes.

Even small and isolated fragments of remnant vegetation are thought to be important as a source of natural enemies of pests, feral honey bees and native pollinators. They may also be refuges for species of conservation interest and in some instances – for example, with Helicoverpa resistant Bt cottons – they can be refuges for susceptible insects in strategies to maintain the efficacy of the GM crops.

The benefits of natural pest control are now widely recognised. Natural enemies suppress a wide range of insect herbivores so preventing many potential pest species from reaching outbreak levels in field crops. The value of the ecosystem service of pest control is estimated at more than US$400 billion a year worldwide.

Area-wide management

If growers are trying to manage a highly mobile species that has several generations a year, then managing it over a larger area would make sense – but would be challenging. For species such as Helicoverpa and diamond back moth (DBM) the main question is how large does a management unit have to be in order to be effective?

These pests need to be managed on an area-wide, season-long basis, which means that all growers in a region will need to cooperate if pest populations are to be reduced.

For Helicoverpa, a generalist herbivore, the use of insecticides (preferably soft spray options such as a specific virus or bacteria) in low value crops such as sorghum may be needed to reduce pest pressure on high input crops later in the season. Such a program appears to have been successfully implemented on the Darling Downs of southern Queensland.

For a host specialist such as DBM, the effects of what is planted where and over what area is likely to have a significant impact on DBM population dynamics. Managing pest populations in crops that are a source of DBM such as canola or weedy Brassica has yet to be explored but minimising natural enemy mortality – by reducing broad-spectrum insecticide use – would be a good start.

If it works on a field/farm scale it will probably also have benefits over a larger area.

Natural enemies

In Australian agriculture, relatively little is known about natural enemies (parasites and predators) and the pests they control. Before serious efforts can be made to restore landscape features and thus increase the abundance and effectiveness of natural enemies, more information is needed on:

- Habitats that are sources of natural enemies and pests;
- The dispersal of beneficial organisms from these habitats into crops; and,
- The landscape scales at which they operate.

Efficient and sufficient pollination services are also important for several broadacre crops though their reliance on
pollinators varies from high (clover 90 per cent, faba beans 50 per cent, field pea 50 per cent) to low (canola 15 per cent, lupin 10 per cent).

Australia has many native pollinators that may be good candidates for supplying agricultural pollination services and preliminary studies on native stingless bees suggest they could be useful low-maintenance pollinators.

American studies have shown that native bees could provide sufficient pollination on more than 90 per cent of the farms studied. But a lack of knowledge about the ecology and biology of native pollinators makes their management difficult for now.

**Competing interests**

Strategies that balance legitimate but seemingly competing interests need to be developed to reverse the negative consequences of some of the changes that come with Australian broadacre grain landscapes.

Before broadacre landscapes to suit multiple users can be designed, the very diverse group of users needs to acknowledge both the need for change and what needs to be fixed. This group includes natural resource managers, primary producers of all description, consumers and other land users such as residential and tourism.

That said, it will probably be the primary producers, with support from the other sectors, who will be charged with implementing landscape changes.

Another challenge is to design landscapes so they benefit a range of ecosystem services. For pest control and pollination the prospects look good. Some insects, such as hoverflies which are predators, provide both pest suppression and pollination services and important pollinator groups such as bees and many natural enemies of pest species depend on similar non-crop habitat.

This suggests that aiming for a (yet to be determined) critical proportion of non-crop habitats in the landscape may be a promising way to enhance both pest control and pollination.

**Using models**

When it comes to gaining a clearer understanding of how changes in landscape composition impact on ecosystem services, the experimental manipulation of landscapes isn’t really feasible. This is where mathematical models can be useful.

These models can help unravel and allow investigation of processes such as colonisation, reproduction, mortality and emigration that underlie the functioning of an ecosystem at appropriate scales.

Models have already been used to explore how the arrangement of non-crop habitats in the landscape can affect pest control in crops, how the timing of crop colonisation by pests affects predators and ultimately pest suppression and how landscape diversity affects one predatory group – spiders.

Ideally, modelling would generate a set of general rules for use in developing management strategies for ecosystem services. For example: ‘the pest control function is likely to be reasonably good in landscapes that contain more than nine per cent of non-crop habitat’. One thing is certain. Designing landscapes for multiple outcomes is a complex problem.

But available evidence suggests grain growers may benefit from area-wide management strategies on a landscape scale in collaboration with growers of other crops with the same pest problems. But there is, as yet little direct evidence that similar area-wide initiatives targeted for natural enemies and pollinators will have a greater effect than managing them locally.

Thanks to the Department of Primary Industries and Water, Tasmania for providing data and to the Cotton Catchment Communities CRC and Land and Water Australia for funding support.

This article is a summary of a paper by Nancy Schellhorn, Sarina Macfadyen, Felix Bianchi, David Williams and Myron Zalucki* on managing ecosystem services in broadacre landscapes: *What are the appropriate spatial scales?* which appeared in the Australian Journal of Experimental Agriculture 48 (12): 1549–1559. It is one of a suite of papers published in this special edition of the journal. *Nancy Schellhorn, Sarina Macfadyen and Felix Bianchi are from CSIRO Entomology, David Williams is from the Department of Primary Industries, Victoria and Myron Zalucki is from the University of Queensland.*

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FARMERS, SCIENTISTS AND CONSERVATIONISTS ARE INVESTIGATING WAYS THAT AGRICULTURAL LANDSCAPES CAN BE MADE MORE SUSTAINABLE BY HARNESING ECOSYSTEM SERVICES, SUCH AS POLLINATION, THAT NATIVE VEGETATION CAN OFFER. (PHOTO BY DENIS ANDERSON, CSIRO ENTOMOLOGY)

NEW COLLABORATIVE PROJECT

The Grains Research and Development Corporation is funding a new collaborative project between CSIRO Entomology, Department of Primary Industries & Fisheries Queensland, Department of Agriculture & Food Western Australia and the University of Queensland.

In agricultural landscapes in north, south and west Australia, they are investigating how grain pests are affected by the composition of the landscape by:

- Identifying source habitats of pests and natural enemies;
- Assessing their movement between habitats such as native vegetation and crops; and,
- Working out how long it takes pests and their natural enemies to colonise crops and how this is influenced by the landscape in which the crops are grown.

The research will identify the features of landscapes that suppress pests and will align IPM guidelines for pest management at several scales – field, farm and landscape. It is hoped the results will help reduce farmers’ reliance on broad-spectrum insecticides, and, at the same time consider the broader public benefits of biodiversity and conservation.

Some of the strategies involved in better landscape design in broadacre cropping regions may also result in improved environmental outcomes such as enhanced amenity and conservation of biodiversity.

Although farmers will probably be charged with implementing these landscape changes, the movement for change may come from a range of stakeholders.
Incitec Pivot’s manages more than 60 trial sites across eastern Australia. The 2008 trials included investigating the timing and placement of fertiliser applications, economic rates of nitrogen and phosphorus as well as the efficiency gains made by various products.

Incitec Pivot’s Market Development Agronomists provide the following R&D overviews into key research and development activities during 2008.

Jim Laycock, Cowra, NSW

In 2008 the long term phosphorus and nitrogen nutrition field trial located at Grenfell to investigate the long-term effects of nitrogen and phosphorus use on productivity and soil health showed significant grain yield responses to phosphorus up to 20 kg P per hectare, compared with nil phosphorus.

There were no significant responses in grain yield to rates of 30 kg P per hectare and 40 kg P above the 20 kg P per hectare rate. All phosphorus treatments were sown over the top of the same phosphorus rate treatments used in 2007 with a starting Colwell P of 29 mg per kg in 2007.

Applications of phosphorus up to 20 kg P per hectare applied as triple superphosphate also increased water use efficiency by up to 40 per cent over the nil phosphorus control. But growers must also be aware when growing wheat on wheat, yellow leaf spot may reduce yield potential.

An enhanced nitrogen field trial at Spring Ridge held last year has shown that current techniques for nitrogen budgeting and assessment may be inadequate for sorghum/fallow/durum wheat rotations on the Liverpool Plains.

The trial investigated canopy management and ways to maximise returns from enhanced nitrogen products. There was a significant grain yield response to both urea and EASY N fertiliser at planting when applied at 140 kg N per hectare.

A late harvest and rainfall at harvest affected quality and protein levels. To achieve target yields and proteins, and depending on soil nitrogen levels, more than 200 kg N per hectare of applied nitrogen may be required under favourable seasonal conditions on the Liverpool Plains.

A Granulock phosphorus field trial at Werris Creek held during 2008, which investigated the economic benefits of Granulock products compared with a range of other starter fertilisers, has shown a significant grain yield response to 20 kg P per hectare, compared with nil phosphorus.

The 2009 trial program in New South Wales will continue to investigate liquid fertilisers and build on the liquids response curve data with trial sites located at Gilgandra, Canowindra, Grenfell and Mullaley.

Bruce Ramsey, Wagga Wagga, NSW

Field fertiliser trials at Griffith and Grogan in New South Wales held in 2008 during the winter crop season continue to support the argument for increasing critical soil Colwell P values in southern New South Wales.

Starter fertilisers used in the trial included triple superphosphate, MAP, DAP, AirSeeder SuPerfect, Granulock SuPreme Z and EASY NPK 27 fertilisers.

ENTEC was also applied to MAP, DAP and Granulock SuPreme Z to test the crop’s response to the nitrification inhibitor.

The trials at Grogan showed significant response to the application of phosphorus up to 20 kg P per hectare at Grogan (Colwell P 37 ppm).

But on the high phosphorus soils at Griffith (Colwell P 104 mg per kg), there was no response to phosphorus.
Time of sowing trials also held at Grogan showed that yield increased by 20 per cent when phosphorus was applied at the end of May rather than the end of June.

Rob Christie, Horsham, Victoria

Phosphorus and nitrogen trials across the cropping regions of Victoria in 2008 continue to show that applications of these nutrients can still provide good yield responses.

The 2008 results from Incitec Pivot’s long-term field trial site at Dahlen continue to show that applications of 9 kg per hectare of phosphorus and 20 kg per hectare of nitrogen are the top returning strategies for maintaining phosphorus levels and providing adequate nutrition in the Wimmera region.

Soil test results from the site also show that applications of 9 kg per hectare of phosphorus maintain and even slightly increase phosphorus levels in the soil.

A similar trial held at Bordertown during last year’s winter crop (in conjunction with Jolpac Rural Supplies) also assessed responses to phosphorus applied at rates of 0, 8, 16 and 24 kg per hectare, and nitrogen applied at rates of 0, 20, 20 + 20 split, 40 and 80 kg per hectare.

There was a significant yield response to phosphorus applications at rates of 16 and 24 kg per hectare at harvest. But there was no yield response to the application of 8 kg P per hectare, compared with the control of 0 kg P per hectare, and no response to nitrogen application rates was apparent.

These were very encouraging phosphorus responses, particularly in the face of such dry spring conditions.

Another field trial at Clunes conducted by the Central Highlands Farming Systems group during 2008 also highlighted the importance of phosphorus fertiliser placement.

Placement of phosphorus near the seed at sowing is important to achieve yield potential.

The optimum economic rate was 10 kg P per hectare in a season characterised by low rainfall and low yields. The highest yields on average were achieved when phosphorus was applied at 20 kg P per hectare.

Grain protein responses occurred only when phosphorus application rates were adequate.

Specialty phosphorus product trials held at the Southern Farming Systems’ trial site at Mininera (Victoria’s Western District) during 2008 also indicated that there is a significant yield response to the application of phosphorus.

In a region where the acidic soils tend to be phosphorus responsive, data indicated that there was a significant yield response to the application of 20 kg P per hectare.

Findings from solid versus liquid fertiliser trials held in conjunction with Incitec Pivot and the Birchip Cropping Group, Agritech Rural, Jolpac Rural Supplies and the Victorian Department of Primary Industries and Agriculture at Sea Lake, Waite, Hopetoun, Walpeup, Bordertown and Horsham sites have shown that liquid fertilisers, such as EASY NP+Zn and EASY NPK 27, perform as well as solid fertilisers.

For more information on any Incitec Pivot trial, contact your local distributor agronomist.
J ust like people, fish need their daily quota of vitamins. For instance, a popular farmed fish, rainbow trout, need at least a dozen different kinds of vitamins so they can grow normally and stay healthy.

Now, ARS fish nutritionist Rick Barrows has made it easier for trout and other fish to get those vitamins. He’s done that by developing an updated, preblended vitamin mix. It’s a publicly available recipe – technically known as a ‘formula’.

And, it’s already being added to fish feeds that are eagerly gobbled up not just by rainbow trout at fish farms and hatcheries, but also by rare and endangered species being raised in captivity for release into the wild.

**Good match for today’s technology**

A new, nonproprietary mix, according to Rick, was needed to replace a decades-old formula that wasn’t adapted to today’s fish-feed processing technology. That technology, known as ‘extrusion processing’, heats and cooks fish feeds, shaping them into firm pellets that are either sold as is or perhaps crushed into smaller bits suited for the tiny mouths of very young fish.

Though extrusion processing has many advantages over previous methods, the heating can damage some vitamins. The formula that Rick developed takes this into account, compensating appropriately for estimated losses.

He combed scientific journal articles and other published literature from around the globe to find the best available data on these losses, then used that information to determine the best quantity of each affected vitamin to use in the new premixed formula. It’s just one of many steps that went into the two years of research and development that resulted in the science-based product dubbed ‘ARS-702’.

Rick went public with the formula – which specifies the type and amount of each nutrient – in 2007. Two major manufacturers of vitamins now make the mix which, in turn, has been added by feedmakers to more than 300,000 kg of fish feeds.

Feedback indicates that the mix has helped invigorate finfish as varied as rainbow trout, walleye, and the endangered Rio Grande silvery minnow.

Rick, who is with the ARS Small Grains and Potato Germplasm Research Unit, developed the vitamin mix in collaboration with ARS teammate and fish physiologist Gibson Gaylord and Ron Hardy, director of the Aquaculture Research Institute at the University of Idaho.

**Nutrient requirements**

In creating the new mix, Rick used nutrient requirements published by the National Research Council – the same federal body that issues nutrient requirements for humans, dogs, horses, and many other forms of life. He gave special attention to myo-inositol, a B-vitamin-like compound.

The older formula didn’t include it, because the fishmeal and fish oil that are the mainstay ingredients of traditional fish feeds provide enough of this nutrient.

But the plant-derived feeds that Rick and aquaculturists worldwide are developing need extra myo-inositol. “It’s a comparatively costly nutrient but skimping on it isn’t cost-effective when you’re using plant-based feeds,” Rick says.

In studies with some 1400 rainbow...
trout. Rick looked at several measures of the mix’s contributions to trout growth and health. The vitamin premix benefited the trout, Rick says, regardless of whether they were eating plant- or fishmeal-based feed.

Plant-based feeds are the future

The plant-based feed used in the study was derived from corn, wheat, and soy. Why the interest in using plants as a major source of fish feed ingredients, replacing the conventional fishmeal and fish oil?

Plant-based feeds will, according to Rick, reduce aquaculture’s reliance on ocean-harvested fish such as menhaden or anchovies. For that reason, these feeds are thought to be more sustainable.

What’s more, plant-based feeds sidestep two other problems, namely high levels of contaminants such as PCBs, found in some ocean-going fish, and high levels of phosphorus, inherent in fishmeal. Though it is an essential nutrient, phosphorus can cause water pollution.

The ARS vitamin mix is a notable example of an effort among aquaculture researchers and plant scientists to help producers make the shift from using familiar fishmeal and fish-oil-based feeds to leading-edge, plant-based feeds.

More information: Rick Barrows, USDA-ARS Hagerman, Idaho Ph: +1 (208) 837 9096, ext. 1109; Fax: +1 (208) 837 6047.

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THE WAY IT WAS – AND IS

The day to day adversaries facing modern farmers are little changed from those experienced by their grandfathers 60 years ago. The fickle patterns of the weather, the illogical gyrations of commodity prices, the inevitable escalations of input costs, the inconsistencies and often absurdities of government policies – these tribulations have been present to worry farmers for as far back as anyone can remember.

What has changed however is the degree of physical hard work and drudgery, which was part of the every day life-style of farmers up until around the early 1960s. By that time, bulk grain handling had replaced the mountains of three bushel wheat sacks, each sack having to be individually laboriously man-handled. The introduction of sophisticated diesel tractors rendered the inefficient kerosene and odd-ball single cylinder crude oil burning tractors obsolete. Bulk fuel had also by 1960 largely done away with the back-breaking and tedious 44 gallon drums.

By the 1970s broadacre tractors were double the horse power of their 1940s counterparts. Correspondingly larger implements meant that three times the area could be worked in a single day. Air conditioned cabins had arrived and CB radios enabled tractor drivers to keep in touch with the outside world.

Mechanised farm technology continued to develop at a bewildering rate, resulting in the computerised and laser guided farming procedures, which are accepted as normal today.

Whilst it would be a brave individual who dared suggest that modern day farmers enjoy an easy cushy existence, it is perhaps psychologically stimulating and good for the soul to draw a comparison and reflect upon what a farmer’s routine would have been like 60 years ago – in 1949.

1949 – MEET BOB THE FARMER AND FRED THE FUEL CONTRACTOR

Bob unhitched the Shearer Majestic eight disc plough from the rear of the big Case LA 50 HP tractor, and headed the perspiring rumbling machine back in the direction of the homestead. It was only 4 pm but Fred was due to arrive from town with a load of fuel and would need a hand with the drums.

Bob eased the hand clutch, bringing the Case to a halt under the pepper tree, near the row of empty 44 gallon drums. Before stopping the engine he had first to remember to switch the fuel taps from kero to petrol. After five minutes of idling, he estimated the petrol would have replaced the
kero in the carby, so it was okay to shove over the spark control and kill the engine. If even a slight amount of kero remained in the carby the engine would refuse to start. Each morning it had to be initially fired-up on petrol, in order to preheat the kero in the manifold hot box before the petrol could be turned off and the kero introduced into the system.

A lot of fiddling really, but at half the cost of drum petrol (which had soared to an outrageous one shilling and 10 pence ha’penny per gallon), and with the big engine gulping three gallons per hour, who could afford to run a tractor on petrol? The real bad news about kero was that it was an abrasive fuel and a portion tended to remain unburnt, which found its way past the piston rings then ended up polluting the oil in the sump. It was necessary to let the engine cool down and settle overnight, during which time the errant kero would rise to the top of the oil and could be drawn off and replaced with an equal amount of fresh oil.

Oil as a coolant

Bob remembered his father telling him that in 1915 he used to drive a Rumely Oil Pull which, as the name somewhat cryptically indicated, used oil in its radiator as a coolant. This enabled the giant twin cylinder engine to run at the extraordinarily high temperature of 160°C – without boiling! So the Rumely was possibly the only tractor that could efficiently burn 100 per cent of its kero fuel.

Fred’s imminent arrival was announced by a rapidly expanding cloud of dust, enveloping his old Bedford as it bounced along the gravel road leading from town. The truck veered from one side to the other as Fred grimly endeavoured to avoid the worst of the pot holes, some of which were “Deep enough for a feller to lose a bullock in” he complained later back in the pub.

Bob watched as the Bedford pulled up at the front gate. Fred stiffly climbed down, opened the gate, pulled himself back into the driving seat and inched the truck through, before again alighting in order to drag the leaning gate closed.

Eventually the hard done-by vehicle pulled up alongside the Case and the empty drums. Fred staggered from his seat and made his way to the front bumper bar, from which hung a locust splattered waterbag. He took a long much needed swig before wiping his mouth with a rag he produced from his rear pocket, retained normally for wiping the dipstick of his truck engine, then turned to the waiting Bob and gasped “Ower yer goan mate.”

Bob stepped into the Bedford and turned the key in the ignition. The starter whirred and a few moments later the engine was sputtering to life. The diesel smell of Fred’s truck mixed with the kero smell of Bob’s tractor. It was a heady combination, and the two men sat in silence, waiting for the engine to settle.

Fred handed Bob a three day old edition of The Sun. After all, no townie visiting a property ever arrived without a copy of the current newspaper. It was just plain bush etiquette and Fred was a stickler for etiquette.

Bob jammed the paper in a fork of the pepper tree for later, then wheeled up a worn out tractor tyre and placed it on the ground at the rear of the truck. Somehow Fred managed to scramble up onto the tail of the tabletop and proceeded to struggle with the first of the thirty C.O.R. Power Kerosene drums. (A full 44 gallon drum weighed around a not inconsiderable 230 kilos.)

Accompanied by grunts and mutterings he pulled it back onto the edge of its rim and waltzed it to the tail, where he deftly tipped it off so that it landed on its side, its fall cushioned by the tractor tyre.

It was Bob’s task to first roll the drum into its position adjacent to the tractor, before grasping the rim and up-ending it to commence a new line. The amount of effort required to up-end a full 44 gallon...
drum was generally a task for two individuals. But Bob had by necessity been doing it on his own for years. A curved spine and constant bouts of severe sciatica were testimony to this fact.

It took nearly an hour for the two men to complete the task of unloading the 30 drums and then hoist the empty ones up onto the tabletop. Even with two men, lifting the empties up onto the high truck required a considerable effort.

Bob signed the delivery docket with a sweaty shaking hand, making sure the carbon paper was in place and mindful of the fact that he was three months behind in paying his accounts. With a bit of luck a wheat cheque would come in, within the next six months – with a bit of luck!

Fred took his leave. Apart from going through the gate, his Bedford would not stop until it had traversed the punishing 80 miles to town and been parked around the corner from The Max Hotel – and its long public bar and ice cold schooners of dark bitter.

**Up to the bank manager**

The next morning Bob had an early start, to make up for the lost ploughing time the day before. The Case was covered in heavy dew. Maybe he would be able to afford a tractor shed next year. Up to the bank manager really!

Now Bob commenced a well practiced routine.

The bung on top of the tractor’s kero tank was undone and the nozzle of the fuel hose inserted. The hand pump, screwed into a kero drum, was supposed to deliver a quart each stroke – but it never did. It took 10 minutes of wearisome pump pump pumping to put in the 30 gallons.

Because of the height of the top of the fuel tank from the ground, Bob couldn’t see into the bung. Accordingly, the only way he knew the tank was full was when frothy kero started misting on his face – and in particular, in his eyes. Maybe this was why he felt he needed glasses. His eyes were often red and sore!

Then it was the turn of the petrol tank. More pumping, but only a gallon this time.

Bob then extracted a shifter from his hip pocket, reached down and proceeded to undo the lower of the two sump oil level plugs. Around a quart of the kero polluted oil flowed onto the ground. The plug was replaced and the upper level plug removed. A Plume quart oil bottle was filled from a Castrol XL drum and poured into the engine sump. When oil flowed out of the upper level plug orifice he knew the correct amount of drained oil had been replaced.

By now Bob’s overalls and hands were decidedly yucky. But there was worse to come – and he hadn’t even started the tractor yet!

The dreaded oil bath air cleaner had to be serviced. This involved unscrewing a steel bar which secured the oil bath reservoir and tipping out the dust charged oil. An old chisel was the tool he used to scrape out the gooey stuff clinging to the bottom of the container. Then yet another quart of engine oil was obtained and poured in, this time from a Purr Pull bottle. The reservoir was fitted back in position.

Bob glanced at his watch. Over half an hour had passed since he had first approached the tractor. But the muckiest job was still to be tackled.

He unscrewed the end of the grease gun and inserted it in the nearly empty bucket of grease. Stone the crows, he had forgotten to ask Fred to bring out a new bucket! Have to ring the mail lady on the party line and ask her to bring one out on Thursday – mail day. Hoped the phone would work – it never did if it rained.

By pulling the handle out, theoretically the grease was supposed to be sucked up and fill the gun without leaving pesky air locks. Well, he might be lucky today. No such luck. It refused to pump. Go through the sticky procedure again.

Fred never worked out how many grease nipples were fitted to the LA Case. But he did know that some psycho design engineer back at Racine, Wisconsin, had located many of them in remote hidden corners requiring that he lie on his back under the tractor and hope that not too much grease ended up on his face or up his sleeve.

**Starting the beast**

Job done! He was now enveloped in grease and other assorted putridity, which would have to remain all day. Never mind. Just get the beast started.

Switch on the petrol, set the magneto control and hit the starter. Strike me pink! The six volt battery was in need of a long slow charge. There was no way it was going to turn over the 403 cubic inch donk.

Nothing for it but to wind it over on the crank handle. Risky at the best of times, because if the advance/retard lever was set a wee bit too advanced, a man could break a wrist if the handle kicked back.

Thankfully for Bob, the engine fired on the third pull of the handle. This early morning routine had by now taken over an hour. About the same time it used to take him to catch, feed and harness a team of horses, he mused.

He pointed the big long nose of the Case in the direction of the cultivation, with the engine now switched over to kero, purring like a – er, Case. The tractor had no power steering, no hydraulics, no air conditioned cabin, no stereo radio, no upholstered comfort seat, no laser guiding and certainly no four wheel drive. It was hot, noisy and rough to ride. But Bob was perfectly content. It got the job done, was a heck of a better tractor than the Fordson next door and providing he got a good crop, it would be paid off by next year.

**IAN’S MYSTERY TRACTOR QUIZ**

**Question:** This weird looking tractor actually performed brilliantly. But what on earth is its make?

**Clue:** This is kind of a cryptic clue. Note the timber (lumber) single chassis member. Think of which country would use timber for this purpose. If you get that right – then you have the name of the tractor.

**Degree of Difficulty:**
Simple – eh?

**Answer:** See page 48.
Whiteheads have often been used as a rough estimate of crown rot ‘risk’. When the percentage of crown rot induced whiteheads is high, it does indicate a high crown rot risk, but the absence of whiteheads does not necessarily mean a low or nil crown rot threat. This is because whiteheads are generally produced when disease infection is combined with crop moisture stress during grain-fill.

In seasons with a favourable finish, high crown rot infections may be present despite the lack of visible whiteheads. Whitehead expression is further complicated by differences in variety maturity and consequently timing of moisture requirement or stress.

- Oats, when infected with crown rot, do not express whiteheads and barley – due to its earlier maturation compared to other cereals – often will not express whiteheads.

Basal or stem browning has been a more reliable tool to identify crown rot risk. This is a reaction to the disease which shows up as brownish areas at the base of the plant, generally visible from head emergence onwards. Although much more reliable than whiteheads, it is still a subjective rating which can vary widely from person to person but better indicates the severity of crown rot infection.

Why is all of this important?

Although the industry has established crown rot ratings for the majority of commercial wheat varieties (largely derived from basal browning and whitehead expression in disease nurseries), it has always been difficult to evaluate the actual yield impact in relation to these ratings.

In recent years, a technique of accurately infecting plots with crown rot inoculum has been developed which has finally allowed a method to evaluate the actual impact of crown rot separate to the environmental impacts.

A new approach

A protocol was developed to evaluate crop and variety performance over a broad geography of the northern region comprising different soil types, planting dates as well as starting and in-crop moisture levels.

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During 2007 and 2008, 18 separate field trials were established in situations where existing crown rot levels were expected to be low. This was to allow a better indication of the actual crown rot impact rather than targeting paddocks with existing high crown rot levels.

The key comparison was that all varieties were evaluated with and without added crown rot at every site. This allowed assessment of the impact of crown rot on yield and grain quality, independent of soil moisture and other site specific factors. Sowing rates of all varieties were adjusted to have an equivalent number of viable seeds per metre of row.

**Clear messages**

Figure 1 shows the mean percentage basal browning by variety across the 11 sites in 2007. The order within both barley and wheat categories ranks varieties from left to right in decreasing crown rot resistance rating. The result for ‘no added CR’ indicates the existing ‘natural’ level of disease across the sites whilst ‘added CR’ is the result when an equivalent amount of inoculum was added to all varieties.

There were a number of clear messages in the pathology results:

- All 11 sites had a pre existing level of crown rot – it is highly unlikely that we can ever eliminate this disease. We need to manage it to ‘low impact’ levels.
- All barley varieties averaged similar or higher severity levels than the range of bread wheat varieties with no clear relationship between percentage browning and variety rating.

**Yield results**

One measure of yield impact of crown rot is to look at the percentage yield loss actually caused by the disease for each crop or variety. Figure 2 shows the mean percentage yield loss by crop across the two seasons.

In 2007 most trials were conducted under tough conditions with high levels of soil moisture stress during grain-fill and generally low final yields. Under these conditions:

- The addition of crown rot resulted in a 20–25 per cent average yield loss across the tested barley and bread wheat varieties.
- Data not presented but there was no difference between varieties in the percentage of plants infected with Fp at harvest. This is not surprising as there is no resistance to initial infection by Fp in any winter cereals, near relative or even grass weeds.

**FIGURE 1: Crown rot severity (basal browning by variety)**

- Basal browning levels in the bread wheat varieties generally supported existing ratings but with only a compressed range between varieties.
- The durum (Bellaroi) recorded increased basal browning at every site compared to all bread wheat varieties.
- In 2007, most trials were conducted under tough conditions with high levels of soil moisture stress during grain-fill and generally low final yields. Under these conditions:
  - The addition of crown rot resulted in a 20–25 per cent average yield loss across the tested barley and bread wheat varieties.
  - Under identical conditions the durum losses averaged 58 per cent with losses greater than 60 per cent at seven of the 11 sites.
  - In 2008, most trials experienced a mild favourable finish. Under these conditions:
    - Barley and bread wheat losses were again similar (though negligible) with significant impact from crown rot on bread wheat yield only recorded at two of the seven sites.
    - Even under favourable conditions the yield loss in Bellaroi averaged nine per cent with significant yield losses at three of the seven sites.

Figure 3 shows the percentage yield loss by barley and wheat variety under the higher yield loss conditions in 2007. Across the 11 sites:

- There was negligible difference in yield loss between barley varieties.
- There was a narrow range in percentage yield loss between the wheat varieties although generally supporting existing crown rot ratings.

A component of the protocol was to examine for a ‘dose response’ to the level of crown rot infection. For the variety Lang, we compared the full rate of added inoculum (2 g/m) to a half and quarter rate (1 and 0.5 g/m). The columns in Figure 4 show the mean percentage yield loss re-
corded in Lang at the various inoculum rates. The lines show the worst case loss achieved in any trial.

The variety comparison in Figure 3 shows only a limited range in percentage yield loss by changing variety selection. The inoculum dose response in Figure 4 highlights a much bigger impact by even halving inoculum levels than achieved by any variety change.

The clear message is that practices that reduce crown rot inoculum levels will have a much bigger impact than achieved with variety selection.

**Yield results – actual yield**

Although percentage yield loss is a valid measure of yield impact, it takes no account of the difference in potential yield between varieties.

Figure 5 clearly highlights the difference in yield potential between the two seasons with bread wheat yields only averaging 1.8 tonnes per hectare in 2007 compared to 3.5 tonnes in 2008. The difference between the two lines within each year shows the impact of crown rot.

Even in a high crown rot yield loss season such as 2007, actual yield appeared more closely related to variety yield potential than the crown rot rating. For example, EGA Gregory recorded the second highest basal browning amongst the bread wheats and the highest percentage yield loss but was still the second highest yielding variety.

Grout recorded the highest basal browning and highest percentage yield loss of the barley varieties but still recorded the highest final yield.

**Grain quality – screenings**

In addition to crop yield, crown rot is known to impact on grain quality and as a consequence can impact on receival grade. Figure 6 highlights the screenings results by variety in the 2007 trials.

- Although barley varieties lost an average 20 per cent yield due to crown rot, there was negligible impact on screenings – barley lost considerable yield but actual grain quality was still maintained. Screenings in the long season variety Gairdner were higher due to the season, not due to crown rot.
- Screenings were significantly increased in bread wheat in seven of eight analysed trials. But seasonal conditions alone resulted in average screenings levels of 11 per cent. The addition of crown rot increased final screenings from 11 to 15 per cent.
Durum screenings were significantly increased in all trials. The addition of crown rot increased screenings from seven to 21 per cent.

Grain quality – test weight

Figure 7 shows the test weight results by variety in the 2007 trials.

- Although barley varieties lost an average 20 per cent yield due to crown rot, there was no consistent impact on test weight.
- Test weight was significantly reduced in bread wheat in three of eight trials. But the reduction in average test weight was less than one kg/hL in all bread wheat varieties.
- Durum test weight was significantly reduced in six of eight trials. The addition of crown rot reduced test weight by an average three kg/hL.

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SUMMING UP...

- Despite years of intensive breeding effort, the levels of crown resistance available are still very low. That is, there is no resistance to initial infection by $F_p$ only partial resistance that appears to slow the rate of fungal progress through the plant.
- Barley is a good host of crown rot and percentage yield losses are similar to those seen in tested bread wheat varieties. But barley grain quality appears less impacted by crown rot.
- Biggest driver of crown rot yield and grain quality loss is ‘seasonal finish’ followed by level of disease inoculum.
- Variety choice cannot be your main crown rot management tool.
- Variety yield and local adaptation have appeared more important for final yield outcome than resistance rating.
- Even in a low disease expression year, percentage yield losses in durum were more than double the loss of the worst performing barley or bread wheat variety.
- It is CRITICAL to check inoculum levels in stubble of northern cereal crops grown in 2008 as high levels of crown rot infection may have been masked by the favourable finish.
The soils of Central Queensland are relatively new (in terms of age of cultivation) and fertile; in the early years of crop production, nitrogen supply did not usually limit production. But with continuous cropping the inevitable decline in nitrogen fertility has occurred and an economic response to nitrogen fertiliser is frequently observed, particularly on open downs soils (shallow black vertosols).

Supplementary nitrogen is primarily being applied as nitrogen fertiliser with a limited amount coming from pulse crops or ley legumes.

Incorporation of legumes, as pulse crops or ley pastures, as a way to reduce fertiliser input is a good option in CQ. High rainfall variability (which makes prediction of optimal nitrogen fertiliser rates difficult), the relatively high cost of nitrogen fertiliser, and the fact that the majority of CQ grain farms also include a beef cattle enterprise, adds to the attractiveness of legumes.

While ley pastures incorporating legumes have been a major component of farming systems in other parts of Australia, their use in cropping systems in CQ has been limited. Reasons for this have included the lack of suitable pasture/fodder legume varieties for the variable climate of the region, lack of agronomic information regarding establishment and removal of legumes, and the poorly defined ‘value’ of ley pastures to farmers.

Butterfly pea (Clitoria ternatea cv. Millgarra) and lablab (Lablab purpureus) have shown potential as ley pasture species to improve the nitrogen and organic carbon content of cropping soils. They are summer

**AT A GLANCE…**

- Both butterfly pea and lablab ley pastures can reduce the nitrogen fertiliser requirement for subsequent crops and provide short to medium term reliable pasture for stock. Lablab is a very productive short term (one to two year) forage legume with nitrogen benefits for following crops lasting about two years. Butterfly pea is not as productive as lablab but as a medium term (three to five year) pasture ley can provide nitrogen benefits to subsequent crops for at least three years.
- Increased plant available nitrogen following ley pastures may not always result in higher yields of subsequent cereals if soil water limits yield. Timing of pasture removal needs to allow adequate duration of fallow to recharge soil water. But higher cereal proteins could increase returns where premium payments are on offer.
- Although difficult to quantify, post-ley benefits for lablab and butterfly pea seem to equate to the rates of fertiliser nitrogen (25–35 kg N per hectare) commonly applied to cereals in CQ.

**FIGURE 1 a:** Plant available water (mm); and,
**FIGURE 1 b:** Plant available nitrogen (kg/ha) at wheat planting
**FIGURE 1 c:** Grain yield (t/ha); and,
**FIGURE 1 d:** Grain protein (%) at harvest following butterfly pea (BFP) or butterfly pea and grass (BFP+G) leys of 3, 4 or 5 years’ duration and continuous wheat (CW) at Baralaba, CQ

Bars within each year marked by a common letter are not significantly different at P=0.05.
mer growing legumes suited to the climate and clay soils of the region.

While there is now more information on the agronomy of ley pasture legumes in cropping systems, there has been less knowledge of the extent and longevity of their nitrogen contribution for subsequent grain crops.

Three trials run by the GRDC-funded CQ Sustainable Farming Systems project looking at the inclusion of butterfly pea or lablab in cropping rotations—has studied their contribution to soil nitrogen for following cereal crops.

**TRIAL 1**

Trial 1 was established on a black vertosol soil that had been cropped (mainly wheat and sorghum) since the 1950s near Baralaba. There were three treatments:

- A continuously wheat-cropped area;
- An area sown to a ley pasture of pure butterfly pea; and,
- A ley pasture mix of butterfly pea and grass.

Butterfly pea cv. Milgarra was planted on February 10, 1998 at seven kg per hectare. The butterfly pea and grass mixture included finecut Rhodes grass (*Chloris gayana*) at 1.25 kg per hectare, Queensland bluegrass (*Dichanthium sericeum*) at 0.68 kg and Bisset bluegrass (*Bothriochloa insculpta*) at 0.1 kg.

Pasture strips were removed on January 18, 2001, February 11, 2002 and March 3, 2003 to create three periods of pasture (3, 4 and 5 years).

Wheat was sown on July 2, 2002, May 6, 2003 and May 30, 2005 (no crop in 2001 or 2004 due to drought).

**The results**

The crops following the BFP only pasture treatment had more plant available nitrogen than the crops following the BFP + grass treatments (Figure 1b). This increased nitrogen availability did not increase grain yields but did produce higher grain proteins (one to five per cent higher) (Figure 1b & d).

Crop yields in the first year after spraying out the ley phase (2002) were lower than continuous wheat due to the much lower plant available water after the pasture (Figure 1a & c). In 2005, when water was not limiting, grain yields were not significantly different between the treatments but all prior pasture treatments still had significantly higher grain protein levels than continuous wheat treatments (Figure 1c & d).

The greatest contribution of the ley pasture to plant available nitrogen occurred two or three years after the removal of the pasture and this was also seen in another trial (see Trial 2) where cereals were planted after two years of butterfly pea or lablab.

**TRIAL 2**

Trial 2 was established in 2000 near Baralaba on a self-mulching, black vertosol. Lablab cv. Endurance and butterfly pea cv. Milgarra were sown on January 15, 2000.

The soil water at planting was sufficient for a satisfactory pasture establishment; plant population (November 2000) was 2.9 plants/m² for Endurance lablab and was 8.0 plants/m² for butterfly pea.

Twelve months later, the lablab population had declined (0.8 plants/m²) but the population of butterfly pea had almost doubled (15.8 plants/m²).

Hence, by February 2002, when all strips were sprayed out to enable cereal planting, the lablab strips were effectively a bare fallow. Crops planted after the legume treatments were wheat in 2002 and 2003 and sorghum in 2004.

**The results**

Over the pasture phase (January 2000 to February 2002) lablab produced more dry matter than butterfly pea, particularly during the first 18 months. But the lablab had almost totally died out by the end of the two years while butterfly pea was still actively growing.

Plant available nitrogen increased for two years following lablab then decreased. After butterfly pea it increased in the second and third years and not the first year (Figure 2). This is probably due to timing of decomposition of the residues.

During the fallow prior to planting wheat in 2002 lablab residues appeared...

---

**TABLE 1:** Grain yields (t/ha) and grain protein contents (%) of wheat (2002, 2003) and sorghum (2004) following two years of butterfly pea or lablab (Trial 2)

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Yield (t/ha)</td>
<td>Protein (%)</td>
<td></td>
<td>Yield (t/ha)</td>
<td>Protein (%)</td>
<td></td>
</tr>
<tr>
<td>Butterfly pea 2 years</td>
<td>1.22</td>
<td>3.80</td>
<td>14.3</td>
<td>13.1a</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Lablab 2 years</td>
<td>1.64</td>
<td>3.70</td>
<td>14.7</td>
<td>12.7b</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Significance</td>
<td>ns</td>
<td>ns</td>
<td>ns</td>
<td>P&lt;0.05</td>
<td>NA</td>
<td></td>
</tr>
</tbody>
</table>

Levels of significance between prior pasture crops are indicated.

NA = not available; ns = not significant (P>0.10)

**TABLE 2:** Effect of lablab or cereal (wheat) on the following sorghum grain yield in 1999–2000 season at Fernlees (Trial 3)

<table>
<thead>
<tr>
<th>Nitrogen rate applied to sorghum (kg/ha)</th>
<th>Grain sorghum yield (t/ha) following wheat*</th>
<th>Grain sorghum yield (t/ha) following lablab*</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>1.9</td>
<td>2.2a</td>
</tr>
<tr>
<td>35</td>
<td>2.3</td>
<td>2.9b</td>
</tr>
<tr>
<td>70</td>
<td>2.8</td>
<td>3.3b</td>
</tr>
<tr>
<td>Significance</td>
<td>ns</td>
<td>P=0.07</td>
</tr>
</tbody>
</table>

Levels of significance among nitrogen rates within prior crops are indicated.

Means within prior crops followed by the same letter are not significantly different at P=0.10.

* In both sorghum crops following wheat or lablab, lodging increased with the increased nitrogen rate; up to 36 per cent in the cereal area and 59 per cent in the legume area with 70 kg N/ha. Yields are adjusted for lodging. ns = P=0.10.
to have completely decomposed while woody residues were still evident after the butterfly pea.

Similar cereal yields, (wheat in 2002 and 2003 and sorghum in 2004), were obtained after butterfly pea or lablab. Grain protein levels were also similar (more than 12.7 per cent) for the wheat crops and indicated no nitrogen limitation on yield (Table 1).

These trials indicate lablab to be a very productive short term forage legume, with temporary nitrogen benefits lasting for about two years. Butterfly pea’s forage production is not as high over the short term, but its greater longevity could provide longer lasting nitrogen supply for subsequent cereal crops.

TRIAL 3

Trial 3 was planted on a shallow black vertosol soil at Fernlees (near Emerald). The experiment incorporated two adjacent areas of the same age of cultivation and recent cropping histories. A lablab–cereal rotation was maintained on the smaller area (32 hectares) while the larger area (122 hectares) was continuously cropped.

Both areas grew wheat in 1997. Lablab (cv Highworth) was planted on December 27, 1997 in the lablab-cereal rotation area, which was grazed by cattle from June 14, 1998 until August 17, 1998. The lablab was removed prior to planting sorghum on January 1, 1999.

Sorghum was also planted in the continuous cropping area on the same day.

Within each area, two replicates of three levels of nitrogen fertiliser (0, 35 and 70 kg N per hectare) were applied.

The results

The prior lablab crop appeared to increase the sorghum yield compared to the continuous cereal by 0.5 tonnes per hectare, averaged across all treatments (Table 2).

Unfertilised grain yield after lablab was similar to continuous cereal fertilised with 35 kg N per hectare, while post-lablab sorghum fertilised with 35 kg N per hectare was similar to that for continuous cereal fertilised with 70 kg N (Table 2).

From this single season bio-assay, lablab appears to contribute 35 kg per hectare of plant available nitrogen. There was no yield loss after lablab in this trial as opposed to what was experienced post-butterfly pea in Trial 1.

A similar trial was planted in 1998 on a black vertosol soil near Theodore with one section planted as continuous cereal (sorghum) and another section as a lablab-sorghum rotation. The sorghum component of the rotation was planted in 1999 and 2001.

The continuous cereal section had two replications of four rates of nitrogen fertiliser applied (0, 30, 45 and 60 kg N per hectare).

The results showed that lablab contributed up to 60 kg N per hectare to the following sorghum crop. In the sorghum crop harvested in 1999 there was no difference in yield between sorghum planted after lablab (4.26 tonnes per hectare) or any fertiliser rates applied (average 4.25 tonnes) but protein was higher in sorghum after lablab. In that year sorghum yielded 3.76 tonnes per hectare without fertiliser. Sorghum harvested in 2001 had a higher yield (4.32 tonnes per hectare) following the second lablab crop (2000) than any of the fertiliser treatments (2.76 tonnes per hectare in 0 N treatment, 3.9 tonnes in fertilised N treatments) but lower grain protein (8.6 per cent) than 45 and 60 kg N per hectare (9.5 per cent).

These trials show that in most years lablab can contribute sufficient nitrogen to grow the succeeding crop of sorghum without additional N fertiliser applied and no yield penalty.

BUTTERFLY PEA AND SOIL ORGANIC CARBON

Preliminary trials show that butterfly pea can have a substantial impact on soil organic carbon.

Measurements of soil organic carbon were taken on a vertosol at Gindie (near Emerald) in 2008. The samples were taken from paddocks with similar cropping histories until one was planted to butterfly pea in 2001, another section was planted to butterfly pea in 2005 and the remainder continued to be cropped.

Organic carbon levels at these sites were 0.85 per cent (continuous cropping), 1.11 per cent (three year butterfly pea) and 1.73 per cent (seven year butterfly pea).

This trend is consistent with other work showing that butterfly pea has the potential to considerably increase soil organic carbon.

Acknowledgements: M. Braunack, H. Cox, S. Buck, D. Reid, M. Conway, R. Routley and R. Sequeira contributed to the research and analyses reported here.

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Phosphorus needs in the north

By David Hall, Market Development Agronomist, Incitec Pivot, Toowoomba

Phosphorus is an essential macronutrient required in large amounts for healthy plant growth. It is important in promoting early root formation, growth and the quality of the grain. Phosphorus is also involved in seed formation, photosynthesis and genetic transfer.

In simple terms, each crop extracts the phosphorus from the soil, which is replenished by either the breakdown of organic matter, such as crop stubble or animal manures, or from phosphorus fertilisers.

The uptake efficiency of applied phosphorus is generally low – approximately 20 per cent gets into the crop.

The balance of applied phosphorus can become fixed into some of the less available pools of soil phosphorus.

In the short term, this phosphorus is not readily available for plant uptake, but over a long enough period of time it should become available for plant uptake, depending on the soil’s parent material.

Unlike nitrogen, and to a lesser degree sulfur, phosphorus is immobile within the soil. So the use of soil phosphorus by the plant is greatly dependent on the levels available in the soil and whether these levels can meet the plant’s requirements.

The following discussion of phosphorus nutrition principles apply to both summer and winter crops. But we need to bear in mind that due to the cooler soil temperatures in winter when mineralisation, or organic matter break down and general soil activity slows, good nutrition management is perhaps even more critical.

**Phosphorus uptake**

The example in Table 1 demonstrates the different ways that phosphorus is taken up by the maize plant. Sorghum has a similar, if not slightly more efficient root system than maize.

Mass flow, which is the movement of plant nutrients in a flowing soil solution toward the plant root, can only supply so much of the plant’s nutrient requirements (about five per cent), with the amount depending on the solubility of the nutrient and the water use by the crop.

Diffusion is the main form (92.5 per cent) of phosphorus supply to the plant roots, whereby nutrients from zones of high concentration move to zones of low concentration.

As a plant root depletes the phosphorus immediately adjacent to the root, it gets replenished from the soil solution with a higher phosphorus concentration outside the depleted zone.

When soil moisture levels are at or near field capacity, such as after rains or an irrigation event, mass flow operates with little impedance and contributes a relatively larger percentage to nutrient uptake.

As soil moisture conditions decrease, mass flow reduces with the plant’s roots relying on diffusion along the concentration gradient to supply phosphorus needs.

In dry seasons this can result in reduced uptake of nutrients like phosphorus and potassium, especially as these nutrients are generally sufficient only in the upper levels of the soil. The plant then has to work much harder to send out a greater root system to find soil moisture, phosphorus and potassium in other areas or at greater depths in the soil.

**Sorghum and phosphorus**

In comparison to other crops, sorghum tends to have a more efficient root system and reduced leaf area that enables it to withstand or partially resist drought.

A sorghum crop deficient in nitrogen can show more marked or easily recognised symptoms than a sorghum crop experiencing phosphorus deficiency.

Sorghum plants that are mildly deficient in phosphorus may just have a delayed maturity without any outwardly visible symptoms. As deficiency increases, the growth reduction is generally greater in the shoot than in the root, but with increasing severity, the plant’s root system may also be reduced. This reduced root system is unable to reach not only soil phosphorus but also soil moisture.

The foliage may become more stunted with the more characteristic dark green to purplish or dark red foliage, leaf sheaths and stems.

Yields last year from Incitec Pivot’s long-term fertiliser trial site at Colonsay were between 4.0 to 5.0 tonnes per hectare. The results from the 2007–08 sorghum crop indicates water use efficiency was running at 16 kg grain per mm per hectare.

Results from the same site also show a significant grain yield response from applying phosphorus over nil. On average, this was 320 kg grain per hectare when applying fertiliser phosphorus in a short-fallow back to back sorghum situation.

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### 2009 Strategies

For farmers to get the best from their phosphorus fertiliser applied to either summer or winter crops, they should:
- Soil test to determine soil phosphorus levels in paddocks;
- Apply the crop’s phosphorus requirement at planting or immediately prior to planting;
- Apply the phosphorus fertiliser in a band, either to the side of the seed or with the seed according to seed safety amounts; and,
- Use a water-soluble form of P.

### TABLE 1: Nutrient demand and uptake mechanisms of maize

<table>
<thead>
<tr>
<th>Nutrient</th>
<th>Demand (kg/ha)</th>
<th>Root interception</th>
<th>Mass flow</th>
<th>Diffusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potassium</td>
<td>195</td>
<td>4 (2%)</td>
<td>35 (18%)</td>
<td>156 (80%)</td>
</tr>
<tr>
<td>Nitrogen</td>
<td>190</td>
<td>2 (1%)</td>
<td>50 (79%)</td>
<td>38 (20%)</td>
</tr>
<tr>
<td>Phosphorus</td>
<td>40</td>
<td>1 (2.5%)</td>
<td>2 (5%)</td>
<td>37 (92.5%)</td>
</tr>
</tbody>
</table>

Crop sensors, canopy management and better decisions

By Nick Poole, Foundation for Arable Research (FAR)

For most growers canopy management has been the adoption of delayed nitrogen, where based on trial results, they have had greater confidence to delay expenditure on inputs such as nitrogen and fungicides and to respond more effectively to seasonal climatic and growing conditions. The approach has been valuable to not only take account of deteriorating spring conditions but also in making greater use of crop models such as Yield Prophet.

There are a number of ways of estimating nitrogen requirement for a crop, for example, soil nitrogen testing and budgeting. But one of the reasons for exploring whether tractor-mounted crop sensors have a role in better N management is that they have a number of potential advantages. They could:

- Give an immediate result of canopy nitrogen status;
- Covering Cropping Systems of southern NSW, Victoria, Tasmania, South Australia & Western Australia

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Nick Poole.
Give an indication of nitrogen status across the whole paddock;
Be relatively quick in comparison to soil nitrogen testing;
Give a better indication of nitrogen supply to the plant than soil testing, since the plant is the indicator not the soil; and,
Be more easily linked to variable rate fertiliser application.

**Are we practicing canopy management?**

Though the process of delaying nitrogen clearly influences canopy size and duration, it is difficult to consider it canopy management. We have no quick or easy means of measuring the canopy size or its water, nitrogen or disease status. So how could we measure canopy size and status quickly in order to make better decisions in the key period of stem elongation GS30–59?

**Role of crop reflectance sensors – what can we visualise?**

Ask the majority of growers how they make decisions on crop inputs and they will tell you it is based on experience and the visual appearance of the crop.

Over the past season, a GRDC project has been examining the role of crop reflectance sensors – such as the Crop Circle and GreenSeeker – to assess whether we can use them to visualise canopy size and nitrogen status.

These tractor or boom mounted sensors measure light reflectance from the crop canopy at different wavelengths of light. We are particularly interested in the red and near infrared wavelengths – the readings of which are strongly influenced by the biomass and chlorophyll content of the canopy. From calculations on reflected wavelengths it is possible to get a measure of crop canopy greenness.

One of the standard indices from crop sensors, such as the GreenSeeker, for estimating canopy greenness is NDVI (normalised difference vegetative index), which is calculated by the simple equation:

\[
\text{NDVI} = \frac{\text{reflectance at the red} - \text{near infrared (NIR) wavelength}}{\text{reflectance at red + near infrared (NIR) wavelength}}
\]

At project trial sites in the 2008 season different crop canopies were established using a range of nitrogen rates. We examined whether NDVI can be used to better
To determine whether there was a relationship between plant nitrogen uptake and crop reflectance, above ground dry matter was assessed at key growth stages in the spring to determine dry matter and percentage N content. Key growth stages were from tillering (GS22) through to flag leaf emergence (GS38–39). This period is regarded as the key timing window for in-crop nitrogen application.

**What we found**

Although data is still being processed, preliminary results have been collected from the three sites: Lubeck; Tarlee; and, Hart. The three trials indicated that under different levels of soil nitrogen reserve, NDVI measured by the GreenSeeker gave a good guide to the amount of nitrogen uptake in the key period from tillering to flag leaf emergence (Figures 1, 2 and 3).

Though there was evidence that beyond GS31 NDVI readings were beginning to saturate (smaller differences in NDVI as crop canopy NDVI scores approached the upper range of measurement), it was clear that at Tarlee – where soil nitrogen reserve was lower and crop canopies more restricted by nitrogen availability (rather than water availability which was the case at Hart) – NDVI still gave a useful guide to plant nitrogen uptake at flag leaf emergence.

At the Lubeck site there was no significant difference in NDVI between the five rates of pre applied nitrogen until GS38 when higher rates of nitrogen gave slightly higher NDVI compared to the zero N control (Figure 4).

In other words, it was not until flag leaf that the GreenSeeker was able to detect small differences in NDVI which also corresponded to differences in plant uptake of nitrogen.

Crop sensors which measure canopy reflectance can give very useful readings of in-crop nitrogen levels.
At the sites with a lower soil nitrogen reserve such as Tarlee, differences in NDVI between the different rates of nitrogen applied at seeding were larger and obvious far earlier in the season. This indicated an earlier exhaustion of the nitrogen in the soil profile and a greater need for applied N (Figure 5).

Early indications suggest that where NDVI readings showed no difference (due to different rates of sowing applied nitrogen) through tillering and early stem elongation, there was no positive yield response to applied nitrogen. In fact yield was reduced (Lubeck, Figure 6).

In contrast at Tarlee there was a significant response to nitrogen application which coincided with significant differences in NDVI from GS31 onwards.

TO SUM UP

Crop reflectance at the red and infra-red wavelengths (calculated using NDVI) showed good correlations with plant nitrogen status at the key timings for in-crop nitrogen application (GS22 – GS38).

It is hoped that these relationships, in conjunction with knowledge of soil water availability, can be used to optimise in-crop nitrogen treatments on a variable rate N application basis.

I would like to acknowledge all the input of my co-workers on this part of the project: Hart & Tarlee (Peter Hooper & Mick Faulkner), CropFacts & Birchip Cropping Group (Brooke Thompson & Simon Craig), NSW DPI (Guy McMullen and Alan Bowring), and the funding of GRDC.

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THE CONSULTANT’S VIEW

By Brooke White, CropFacts Pty Ltd

Canopy management is essentially seen by many growers as nitrogen management. From the 1990s to the early 2000s in the Victorian Wimmera, standard practice was to pre-drill all nitrogen up front prior to sowing. A typical application was about 100 kg per hectare of urea. If it turned out to be a good season, a grower might top up nitrogen levels in-crop to achieve higher yields.

The main problem with this system was risk. Growers applying nitrogen up front did not know if the season would be good, bad or average, and therefore didn’t know if there would be a return on their nitrogen investment.

More recently, Wimmera farmers have completely moved away from applying nitrogen up front to cereal crops. Particularly with wheat, all nitrogen is now applied post seeding, usually just one application after the end of tillering (GS30). The majority of nitrogen applied is still urea, although in some cases growers are also using UAN.

There are several benefits of this practice in addition to better risk management. These include savings on nitrogen and pre-drilling costs, conserving soil moisture for when the crop needs it more, and more efficient photosynthesis through better canopy structure. Growers are no longer pleased to see lush canopies.

Making the decision to apply nitrogen, and when to do it, causes the most concern for growers working with this system, and a few sleepless nights too. Many growers have agonised over the decision, although in recent seasons their angst has been exacerbated by the dry finishes to the season.

Determining how much nitrogen is required is highly important. In the Wimmera, growers generally rely on a pre-sowing soil nitrogen and moisture test, and in some cases an in-crop soil test for nitrogen and soil moisture, to formulate their nitrogen budget. Decision support tools, such as Yield Prophet, that determine the likelihood of getting a response to applying extra nitrogen can help a grower avoid sleepless nights.

The use of crop sensors to determine nitrogen levels is still in its infancy in Australia, but it promises to add another tool to support nitrogen decision-making. In trials we are currently using hand-held active sensors, although commercial systems will use vehicle-mounted sensors so that every time a grower makes a pass over the paddock they can get a nitrogen reading, which can be used to formulate a fertiliser plan.

It’s hoped that these relationships, in conjunction with knowledge of soil water availability, can be used to optimise in-crop nitrogen applications on a variable rate basis.

Brook White: “When and how much nitrogen to apply in-crop causes a lot of farmer angst.”

AT A GLANCE…

• Up to now, canopy management for most growers has revolved around delaying nitrogen application – but unless there are easy ways of measuring a crop canopy, it is difficult to see how it can be managed.

• Crop sensors measuring the reflectance from the cereal crop canopy, may offer a better opportunity for defining the size and status of the canopy, and better information for making in-crop input decisions.

• From preliminary studies, crop reflectance showed good correlations with nitrogen in the above ground biomass of the plant.

• The correlation between plant N uptake and NDVI was very strong when different growth stages between tillering and flag leaf emergence were compared.

• Where different nitrogen rates were applied at sowing, the correlation between NDVI and plant nitrogen uptake was dependent on the level of soil nitrogen present at sowing.

• Lower soil nitrogen reserves resulted in greater differences in NDVI when different levels of applied seedbed nitrogen were compared. The NDVI differences also showed up earlier in plant development indicating that NDVI would be the basis of a useful guide for predicting soil nitrogen reserve.

• It is hoped that these relationships – in conjunction with knowledge of soil water availability – can be used to optimise in-crop nitrogen applications on a spatial basis.
The current farming system on Cape Lagoon Farms has served it well for the past 10–15 years integrating a regular pulse phase in the rotation. This has lead to a steady increase in wheat yields in a challenging low rainfall environment with difficult soils. Different pulse crops have been trialled over the years and now field peas are the mainstay of a sustainable system.

A regular pulse crop aims to address several long term issues on the farm:
- Cereal root disease;
- Nematodes; and,
- Resistant ryegrass.

Field peas are a non host plant which has dramatically reduced cereal root disease in Ron’s program. The later time for field peas (Ron’s target sowing date is May 25) and the ability to crop-top them, means resistance ryegrass can be effectively managed during this phase of the rotation.

Faba beans were tried for three years but were found unreliable compared to field peas. Vetch was also introduced and has been a successful green manure crop on the farm but mainly used to target areas of low fertility or high weed burden. Vetch is also used to keep the area of field peas to harvest down to a manageable level.

The nitrogen boost from either crop is equally important, especially in times of high nitrogen prices.

Canola has been trialled on and off for the past decade and Ron considers his farm is still a little too marginal for this.
oilseed. It is still treated as an opportunity crop when soil moisture is good at the start of the growing season.

Ron believes that canola will play a more significant role on the farm in the future especially with recent developments of shorter season varieties. Not only will canola raise the profitability, but it will also give the opportunity for two successive break crops to seriously reduce grass weeds and root diseases during the cereal phase of the system.

In 2007 the crop program consisted of basically a third each of wheat, barley and field peas and in 2008 barley was cut back and replaced with canola.

The wheat-barley-pea rotation is the one which has been followed in recent years and Ron believes that this rotation gives a good mix between profitability and sustainability.

In 2008, around 10 per cent of the farm was sown to canola largely at the expense of barley (Table 1).

**BREAK CROP CHOICE**

Field peas have been the break crop of choice on Cape Lagoon Farms due to their adaptability to the heavier soils. The inclusion of field peas from one year to the next is based on a set rotation: wheat–barley–field peas.

Field peas also have the advantage of a more flexible seeding window in a tough mallee environment where the break can be quite variable.

Control of weeds and crop diseases has been the main driver for tight rotations between pulse crops.

**TABLE 1: Crop mix on Cape Lagoon Farms as a percentage of total crop area**

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Barley</th>
<th>Field peas</th>
<th>Canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>2007</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>35</td>
<td>25</td>
<td>30</td>
<td>10</td>
</tr>
</tbody>
</table>

Last year a small area of canola sneaked into the program as an opportunity to increase the frequency of broadleaf crops grown. Canola replaced some barley in the rotation and these paddocks are usually chosen due to higher grass populations, and to a lesser extent, disease.

Summer weeds can also have some influence on the break choice with field peas being easier to manage where weeds have got away over summer.

What amount of the whole system is sown to pulses is influenced by the proportion of the farm which can handle a lower but reliable profit margin. The carryover benefits of field peas are also taken into consideration when working out the profitability of each paddock in the system.

**ROTATION DRIVERS AND PROFITABILITY**

Over the past eight years Cape Lagoon Farms’ wheat yields have improved from around 1.2 tonnes per hectare to over 2.3 tonnes at present. The focus has always been to increase yields – which is the main profit driver – in the most economic and sustainable way.

Ron attributes the yield increases to the effect field peas have on root diseases, soil fertility and nematode suppression. All things being equal, he estimates they add an extra 0.75 tonnes per hectare to wheat compared to wheat on wheat in their environment – a crop sequence he rarely does.

Field pea yields have remained around 1.2 tonnes per hectare since the early nineties with black spot being the biggest challenge.

Recent studies have shown that field peas rarely respond to phosphorus and as a result of this research, no fertiliser was applied to peas in 2008. This has dramatically increased profit margins for field peas but Ron does not think a production system of no fertiliser under field peas will be sustainable.

Wheat following field peas generates the best profit margin across the farm given the lower nitrogen requirement and disease break. A good season in 2007 – combined with strong commodities prices – saw wheat net over $800 per hectare. Field peas averaged just over $300 per hectare with yields of 1.26 tonnes per hectare (Table 3).

**TABLE 3: Summary of recent average yields, production costs and returns for Cape Lagoon Farms, Grass Patch**

<table>
<thead>
<tr>
<th></th>
<th>Wheat</th>
<th>Barley</th>
<th>Field peas</th>
<th>Canola</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of production (2007)/ha</td>
<td>$221</td>
<td>$202</td>
<td>$212</td>
<td>$203</td>
</tr>
<tr>
<td>Average yield t/ha</td>
<td>2.53</td>
<td>2.69</td>
<td>1.26</td>
<td>0.85</td>
</tr>
<tr>
<td>Gross income</td>
<td>$1038</td>
<td>$982</td>
<td>$524</td>
<td>$595</td>
</tr>
<tr>
<td>Average net return/ha</td>
<td>$817</td>
<td>$780</td>
<td>$312</td>
<td>$392</td>
</tr>
<tr>
<td>Average yields last 5 years t/ha</td>
<td>2.60</td>
<td>2.20</td>
<td>1.30</td>
<td></td>
</tr>
</tbody>
</table>

Field peas were originally introduced to the Cape Lagoon Farms’ rotation to help arrest wheat diseases.
Last year’s production was down slightly with wheat yield averaging 2.30 tonnes per hectare and field peas down to 0.70 tonnes per hectare. Barley suffered wind and some hail damage in 2008 to average a disappointing 1.30 tonnes per hectare.

Two paddocks of Tanami canola averaged 0.85 tonnes per hectare in 2007 but with canola prices hovering around $800 per tonne, their net return was approximately 25 per cent more than field peas.

In 2008 the profitability of canola and field pea crops was on a par as yields dropped to 0.90 and 0.70 tonnes per hectare respectively.

Though follow-on benefits have to be taken into consideration, a lot of thought goes into determining the most profitable pulse component into the rotation in any one year.

**FUTURE SYSTEMS**

Ron and Kerry are happy with how far the farm has come over the past two decades and see that any changes in the near future will revolve around fine-tuning the present rotation. Canola will start to play a bigger role on the farm and provide extra management options.

Another legume similar in characteristics to faba beans would be ideal. A legume which performs as well as field peas and attracts higher commodity price, would give the business extra options and hopefully increase profits.

Variable Rate Technology (VRT) is likely to be another addition to the management options and applied to sowing, spraying, and spraying operations. VRT would potentially lower production inputs and increase productivity by placing inputs where they are most needed.

Genetically modified crops in the future may provide the opportunity to offset risk from environmental influences such as frost, drought, and salinity.

Ron is enthusiastic about GM use in herbicide resistant crops but warns that very careful management is needed. He believes managing weeds through the system is a more sustainable way to go.

Break crops on Ron and Kerry’s farm are here to stay. An increase in the use of break crops as part of the farm’s rotation is likely to occur in the near future. Ron constantly sees an increased grain production as a result of his pulse crops. Pulses have greatly increased the productivity and profitability of Cape Lagoon Farms.

Acknowledgement to Tim Pohlner, Farm and General, Esperance for the original article.

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**Hybrid lupin world first**

A dainty pink flower with a tinge of yellow is one characteristic of a hybrid plant representing a genetic pathway to transfer best plant characteristics between narrow-leaved and yellow lupins.

The hybrid, a world first, is the result of 1600 crosses made during 2008 by researchers based at the Centre for Legumes in Mediterranean Agriculture (CLIMA) at The University of Western Australia (UWA).

Dr Jon Clements, Project Leader for the Grains Research and Development Corporation (GRDC) supported project, said the aim was to transfer desirable characteristics from yellow lupin (*Lupinus luteus*) to narrow-leaved lupin (*Lupinus angustifolius*).

“Narrow-leaved lupin is the most important grain legume in WA due to its adaptation to infertile sandy soils, reasonable tolerance to pests and diseases and its use as a break crop,” Jon said.

“Yellow lupin has superior seed quality to narrow-leaved lupin, but is susceptible to anthracnose and aphid damage.

“This breakthrough in producing flowering hybrid plants between these two species creates the opportunity to transfer traits from *L. luteus* to *L. angustifolius* and vice versa,” he said.

Confirmation of the hybrids was made by visually intermediate plant characteristics and also through molecular marker analysis.

Jon emphasised that achieving the hybrid cross had been a team effort by John Quealy, Leah Chong, Dr Larissa Prilyuk, Dr Hua’an Yang and Gordon Francis – the group who crossed thousands of flowers and tissue-cultured hundreds of embryos to generate a few individuals.

He also acknowledged the valuable input from past team member Dr Julia Wilson and collaborators Dr Heather Clarke, Dr Bevan Buichell, Professor Craig Atkins, Dr Mark Sweetingham and Professorial Fellow John Kuo.

“One challenge to be overcome is crossing lupin species with differing numbers of chromosomes,” Jon said.

The next step will be backcrossing the hybrids to lupin cultivars and incorporating them into the breeding program managed by Bevan Buichell, Senior Lupin Breeder at the Department of Agriculture and Food WA (DAFWA).

The introgressed genes would then be tracked using molecular marker assisted breeding in molecular geneticist Dr Hua’an Yang’s laboratory at DAFWA and further cytogenetic work would be done at UWA, depending on funding.

Brondwen MacLean, GRDC Manager for Pulse and Oilseeds, said growers were keen to see lupins become more valuable.

“While the breeding program is clearly focussed on increasing yield, yield potential must be considered in the context of cultivars requiring traits which ensure grower adoption and market acceptance.

“As lupins are price benchmarked against the dominant market positions of soybean meal and canola meal, increasing protein and sulphur amino acids in narrow-leaved lupin is important to increase the price paid,” Brondwen said.

Jon will present on the new hybrid at the 14th Australian Plant Breeding Conference at Cairns in August.
A powerful spotlight is shining on the Institute of Agriculture (IOA) at The University of Western Australia (UWA), with an impressive long list of prestigious awards, scholarship grants and healthy student enrolments.

The recent prize windfall for three young UWA IOA students at the Young Professionals in Agriculture Forum, hosted by the Department of Agriculture and Food WA (DAFWA) at the Grains Research and Development Corporation (GRDC) supported 2009 WA Agribusiness Crop Updates, clearly demonstrates that effective solutions to the problem exist.

Stephen believes subsoil compaction and acidity in many sandplain soils go hand-in-glove and treating both problems is the key to improving productivity.

Drawing on 2008 experimental results from a property at Maya in the Mid West, he said deep ripping to 50 cm, combined with deep placement of lime, improved crop growth due to better access to water and nitrogen early in the season.

The experiment at the site was established in 2005 and yields in the two years the site has been cropped, 2005 and 2008, were 3.3 tonnes per hectare for the deep ripping and deep lime to 50 cm treatment, compared to 2.5 tonnes per hectare for the untreated control, demonstrating obvious benefits in reasonable seasons.

By contrast, surface applied lime treatments and lime placed to 30 cm with deep placed nutrients at the site showed no significant yield increase.

The deep ripped soil reduces penetration resistance and greatly increases wheat root abundance.

Not only are yields increased with deep ripping and deep liming, quality is improved too, with reduced screenings and higher hectolitre weights.

Treating the problem is one thing, but a gram of prevention’s worth a kilo of cure. Stephen said the best strategy is to prevent subsoil acidity with regular liming at sufficient quantities to maintain soils pH at or above 5.5 and minimise compaction by using a controlled traffic (tramline) farming system where possible.

Managing soil pH should be seen as a long term investment to prevent soil degradation and sustain productivity.

The amelioration treatment is highly profitable, with an estimated gross margin benefit of $1.59 per hectare at the Maya experiment site, compared to the untreated control – and the benefits are long lasting.

Surface applied lime in sufficient quantities has been shown to provide a benefit for 12 or more years in other research trials and large scale on-farm demonstration sites.

The Crop Doctor is GRDC Managing Director, Peter Reading, Ph: 02 6166 4500.

Further Information: Dr Stephen Davies Ph: 08 9956 8515.
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Domestic grain outlook

**Wheat – RALLIES ON STRONG FUNDAMENTALS AND OILSEEDS**

After last week’s drop in values we saw a welcome turn around in global wheat prices. The rally was brought on by continued delays in wheat plantings, a strong oilseed market and aggressive short covering in wheat futures.

Egypt purchased 60,000t of Canadian wheat at US$179/t FOB, with US SRW $4–14/t higher, Russian $1–8/t higher and French $10–18/t higher, which puts origin values in the tightest range for a while. Iraq was also buying last week, picking up 100,000t of Australian wheat for Jun/Jul at US$240/t (A$300/t port equivalent), 100,000t Canadian at US$236/t and 50,000t German wheat at US$222/t.

US winter wheat planting is still slow, but not worse than the market has been expecting. Spring wheat is 23 per cent planted vs 15 per cent last week and 59 per cent normal. The main concern is North Dakota, which has only planted 3 per cent of their crop so far vs a 51 per cent average. North Dakota produces 15 per cent of the US wheat crop – at the top of the list along with Kansas at 7–8 mt per year – and more importantly for protein and grade spreads produces 50–60 per cent of the US durum crop and 40–50 per cent of the US spring wheat crop.

The International Grains Council, forecasts the 2009–10 global wheat crop to be 651 mt – down 37 mt vs 2008–09. With dry conditions across the CIS and a general trend to more normal yields, we could see production lower than this. However, we wouldn’t necessarily view this as bullish given the higher opening stocks and softer demand.

Local values have managed a modest lift this week, up A$5–10/t in thin trade with movement in basis and futures largely offsetting each other.

**Canola – EUROPE PLAYS CATCH-UP BOOSTING AUSSIE CANOLA VALUES**

Oilseeds put in a pretty solid week with spot beans pushing to their highest level since September 2008 with a close above $US11/bu. Markets continue to figure out how to ration old season demand with a huge export program getting bigger thanks to continued cuts to bean production in Argentina – there are talks that the crop is as low as 31 mt, but most still see it around 34–35 mt.

Canola prices made some good ground this week (up CA$20/t) – despite continuing to lag soybean prices in spot months – which again attracted some farmer selling across Canada.

The big mover this week has been the EU markets. With a day off for May Day, EU values come out with a bang this week in an effort to play catch up to global strength during their holidays and also price – in the increased weather risk that is dawnning on the Black Sea and European countries.

This EU strength is helping our Aussie values – Victorian prices pushing over A$540/t port and WA prices over A$525/t FIS Freo, which attracted some light selling from east-coast farmers in time with the recent rain.

New crop prices in Australia are also picking up a few ears, with east coast prices above A$560/t port and WA prices over A$560/t FIS. But despite the strong prices, farmer selling remains low with basis levels still weak and dryness in WA. The dry weather in WA is likely to see hectares move from canola across to wheat and barley; however we shouldn’t see a mass exodus yet with many growers happy to plant into the second half of May.
New water stress insurance

By John van der Vegt, AgriRisk Services

All manufacturers face production risks. But Australian farmers are out on their own in terms of having their income producing assets so heavily exposed to natural perils. And of all the crop producers, Australian dryland wheat farmers arguably have to deal with the highest level of production risk.

Depending on their location crops are routinely exposed to insufficient and excessive rainfall, drought, frost, hail, flood, fire, disease and so on. Managing the majority of these risks is difficult and in some circumstances impossible.

**Multi-Peril Crop Insurance (MPCI)**

When a large number of growers are impacted by the same peril, these growers can often seek government assistance through the exceptional circumstances provisions – but this process is often complicated and inequitable. These situations also reignite the groundswell for more comprehensive insurance programs such as MPCI.

MPCI programs operate in a number of developed and developing countries around the world. As their name implies, they offer significantly broader coverage than the single or named peril (such as fire and hail) policies on offer to Australian farmers.

In some instances the MPCI programs provide an income guarantee for farmers virtually transferring all production (and often marketing) risks to the insurer.

**So why aren’t MPCI programs available in Australia?**

Following significant frost losses in Western Australia in the late 1990s a government taskforce was established to look at the feasibility of establishing an MPCI program for Australian wheat growers. In 2003 the task force concluded that the cost of the cover would be relatively high – in many areas above 10 per cent of crop revenues – and as a consequence the participation of growers would be low.

This would increase ‘adverse’ selection by growers – whereby higher risk growers would tend to take up the insurance due to their higher likelihood to make a claim. It was therefore concluded that most insurers would not be interested in providing the coverage simply because they did not see how they would make a return on their investment in the product.

After reviewing many successful MPCI programs, the taskforce noted that they seem to have two key features:

- Strong government support – generally the level of support via premium subsidy is higher than 50 per cent. This of course makes the premiums far more affordable for growers. In the US the government’s contribution to MPCI exceeds US$8 billion.
- The insurances are compulsory – this removes the moral hazard aspects, guarantees a premium pool and allows the government to remove any other exceptional circumstances type funding.

Also in many of the countries where MPCI is successful, there is a strong rural economy and a significant voting base. By significantly funding an MPCI the government can ensure the viability of these rural economies and hopefully secure their voting base.

In contrast, Australia of course has a very small rural voting base and it is fair to say that the government is less likely to provide significant assistance to a single interest group on the basis of inequity, notwithstanding the importance of the wheat crop to Australia’s economy and a significant voting base. By developing an MPCI the government can ensure the viability of these rural economies and hopefully secure their voting base.

**Managing the rainfall risk**

Whilst there doesn’t seem to be a solution to the MPCI issues in the short term, the specialist crop insurer, Primacy Underwriting Agency, have been looking at MPCI to ascertain whether an alternative program might assist growers in managing their production risks.

Primacy have analysed dryland wheat growers’ production risks and found that some 70 to 90 per cent of yield variability is attributable to rainfall, either insufficient or excessive. This is followed by hail, frost, fire and disease.

Rather than trying to manage all of these perils like an MPCI program, Primacy have concentrated on managing the most critical risk – rainfall.

Last season Primacy introduced YieldShield, an innovative insurance product designed to assist dryland wheat growers in managing water stress (insufficient or excessive rainfall) once their crops have reached first jointing.

The product was released on a limited pilot program basis available across 100 growing shires.

Based on solid grower feedback during this 2008 pilot phase, the product has been simplified and released for the 2009 winter cropping season. It is ideally suited to larger crop growers looking to manage their exposure to water stress.

They will generally be growers who try to forward sell their production and are then concerned about their exposure to contract washout. They are also likely to be growers who have previously looked at marketing tools or rainfall derivatives to manage the risk.

**Yield Shield**

YieldShield is only available through a limited number of accredited insurance brokers including AgriRisk Services. For more information contact AgriRisk on FREECALL 1800 659 034 or yieldshield@agririsk.com.au
Over past months the federal government has announced a number of measures to help stimulate the Australian economy in the face of global recession. One measure of particular value to farming businesses – but one that has not received a lot of attention – is a proposed 10, 30 or 50 per cent investment tax break.

The temporary business tax breaks are only available this year with cut-off dates and the amount of tax break you are eligible for, depending on your business size. Small businesses with a turnover of $2 million a year or less can claim an additional 50 per cent tax deduction for eligible assets costing $1000 or more that they acquire from December 13, 2008 to December 31, 2009, and install by December 31, 2010.

This deduction can be claimed when lodging the business income tax return and is in addition to the usual depreciation deduction in respect of the asset. The date of delivery or installation determines the financial year in which you can claim the tax deduction.

Businesses with larger turnovers (more than $2 million per year) can receive a 30 per cent deduction for eligible assets purchased between December 13, 2008 and June 30, 2009 and installed by June 30, 2010. A smaller 10 per cent investment allowance for larger businesses, is available for eligible assets purchased between December 13, 2008 and December 31, 2009 and installed ready for use by the end of December 2010.

**Eligible assets**

Assets eligible for the temporary allowances are new tangible depreciating assets, and new expenditure on existing assets, used in carrying on a business in Australia.

Under the relevant tax legislation, they are assets for which a deduction is available under the core provisions of Div.40. Land and trading stock are excluded from the definition of depreciating assets, and will not qualify for the deduction.

**A worked example**

A large farm business (more than $2 million turnover per year) entered into a binding contract to acquire a new backhoe on May 20, 2009 at an all inclusive cost of $60,000 (ex GST). The backhoe is delivered and ready for use on June 20, 2009.

The business will be entitled to claim the 30 per cent deduction because:

- A backhoe is a depreciating asset for which the business would be entitled to claim a tax deduction;
- The asset exceeds the expenditure threshold of $10,000;
- The business started to hold the asset between December 13, 2008 and the end of June 2009; and,
- The asset was installed ready for use before the end of June 2010.

The deduction will be 30 per cent of the asset’s – that is, $18,000.

If the farm had delayed this investment until, for example, September 1, 2009 but had the backhoe ready for use before the end of December 2010, the 10 per cent rate would apply – a deduction of $6000.

**SOME FREQUENTLY ASKED QUESTIONS**

**What does ‘new’ mean?**

The tax break will be available for new, tangible depreciating assets or new expenditure on existing assets. ‘New’ refers to assets that have not been used before by anyone, anywhere.

**Do cars qualify?**

New motor vehicles used for business purposes are an example of the kind of assets that could qualify for the tax break (provided all the criteria are met). Demonstrator vehicles can qualify as ‘new’ assets provided they have only been used for reasonable testing and trialling.

**Does computer software qualify?**

No, the assets must be tangible.

**Will assets held under leases qualify?**

Provided the asset being held under lease is a new, tangible, depreciating asset (for which a deduction is available under Div.40), then the asset will be eligible.

Div.40 provides a framework for determining who in a leasing arrangement is able to claim depreciation deductions in respect of the asset and hence would be entitled to claim the bonus deduction in a leasing situation.

As is currently the case with capital allowance deductions, how the tax break is
factored into lease prices will be a matter for commercial negotiations.

In general, the finance company providing the lease would claim the investment allowance and pass on all or some of the tax benefit to the customer by way of a reduced lease interest rate.

Do buildings qualify?

No.

Are primary production assets, depreciated under subdivision 40-F (for example, water conservation facilities) eligible?

No. Assets that already receive concessional capital allowance deductions under other subdivisions – such as 40-F – will not qualify.

What if I don’t meet the June 2010 installation deadline?

If you are a large business and acquire or start to hold an eligible asset between December 13, 2008 and the end of June 2009 and miss the end of June 2010 installation deadline, you will miss out on the 30 per cent deduction.

But provided the asset is installed by the end of December 2010 you will still qualify for the 10 per cent bonus deduction.

Will the tax break be reduced for non-business use?

The tax break will not be apportioned for any non-business use of the asset.

But a taxpayer must be able to demonstrate that at the time they started to use the asset or had it installed ready for use, the asset was to be used in Australia and for the principal purpose of carrying on a business.

Will the tax break bring forward the deductions I would normally claim over the asset’s effective life or is it on top of these deductions?

The tax break will provide a bonus deduction rather than bringing forward normal deductions for an asset’s decline in value. This means that, over time a taxpayer – depending on business turnover – could effectively claim deductions of up to 150 per cent of the asset’s value.

The tax break will not impact on balancing adjustment events. For example, the tax break will not affect the tax treatment of an asset upon disposal.

Will the luxury car limit apply to the tax break?

Luxury cars have their cost reduced to the car limit for the purpose of calculating capital allowance deductions.

And as the tax break relies on the core provisions of Division 40, the car limit will apply to eligible luxury cars.

This means that a taxpayer who is eligible to claim the tax break for a luxury car will have to use the car limit when working out the amount of their deduction.

The car limit for 2008–09 is $57,180 so this means that, at the 30 per cent rate, the maximum bonus deduction available for a car this financial year is $17,154.

* The business tax break is subject to parliamentary approval and eligibility will depend on individual circumstances.

Thanks to Greg Kelly, Williams & Partners Chartered Accountants, Brisbane (Ph: 07 3221 2416) for his professional review of this article.

15 MILLION HECTARES OF WATER-STRESSED WHEAT.
ONE SPECIALIST BROKER.

YieldShield

YieldShield is an innovative new product designed to assist dryland wheat growers in managing their most significant production risk, Water Stress. It is a package policy that includes Fire and Hail Insurance. For more information on this new product contact AgriRisk Services

FREECALL 1800 659 034 OR EMAIL yieldshield@agririsk.com.au
The proposed 10, 30 and 50 per cent temporary tax breaks for equipment purchases will only be available to farmers who order this year, so Case IH Marketing Manager Stuart Brown says anyone considering a new purchase should talk to their tax advisor and plan a visit to their dealership now.

“Any farmer who has been thinking about upgrading their equipment over the next 18 months should consider whether buying now could be to their advantage,” Stuart says. “This tax break is a one-off opportunity that could potentially be worth thousands of dollars to businesses. Case IH has released a wide range of new products for 2009 so this is a great time to think about upgrading to equipment that will help boost productivity on your farm.”

Under the proposed tax breaks, orders placed this year will qualify for a 10, 30 or 50 per cent tax deduction depending on business turnover and equipment delivery date (see Case Study box for more details).

“With strong global demand for equipment it makes sense to order early anyway,” Stuart says. “That way farmers will not only put themselves in a position to potentially take advantage of the tax break, they’ll also ensure their order is prioritised.

“Local and overseas demand is still at very high levels and the tax break cut offs could create an even stronger run on products, possibly making it difficult to source machines on short notice. We’ve secured extra production of high horsepower tractors and combine harvesters to help meet the projected demand, but it’s always good practice to order sooner rather than later.”

Case IH dealerships can also help customers finance their purchases. “We can arrange competitive finance and with our CNH Capital Express offering, eligible customers will have their finance approved in under 90 minutes. This is in addition to great rates from a lender that has machinery finance as their focus.”

The temporary tax breaks are subject to parliamentary approval and eligibility will depend on individual circumstances.
Australian Grain has asked rural taxation specialists, Williams and Partners Chartered Accountants, to provide a case study which helps to answer the typical questions their clients are asking about the proposed investment tax breaks.

PROPOSED INVESTMENT TAX BREAKS – A CASE STUDY

By Greg Kelly, Director, Williams & Partners

The proposed investment tax breaks are a 10, 30 or 50 per cent extra tax deduction for certain new tangible, depreciable asset purchases. To qualify, the cost of the asset must exceed $1000 for small businesses (that is, a turnover of $2 million a year or less) and $10,000 for all other businesses. There is no asset cost upper limit.

The deduction rate is applied to the ex-GST cost. The table below sets out the vital cut off dates to gain the tax breaks.

<table>
<thead>
<tr>
<th>Acquisition deadline</th>
<th>Installation deadline</th>
<th>Investment deduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small business (&lt;$2m turnover) (per May 09 Budget announcement)</td>
<td>13/12/08 – 31/12/09</td>
<td>31/12/2010</td>
</tr>
<tr>
<td>Other businesses (&gt;=$2m turnover)</td>
<td>13/12/08 – 30/06/09</td>
<td>30/06/2010</td>
</tr>
<tr>
<td></td>
<td>13/12/08 – 31/12/09</td>
<td>31/12/2010</td>
</tr>
</tbody>
</table>

Farmer Burley goes to town

On June 29, 2009 Farmer Burley (a small business operator) buys a new tractor and it’s delivered to the farm the next month.

The new tractor costs $300,000 net of GST. It is financed by Commercial Hire Purchase.

The investment tax break of $150,000 is claimed in the financial year of installation – in this case 2010. The depreciation and interest deductions would be claimed as normal over the life of the asset and terms of finance respectively. The following tax break calculation assumes a tax rate of 30 per cent.

Investment allowance | $150,000
Ex GST cost of tractor | $300,000
Investment tax break @ 50% | $150,000
Cash tax benefit | $45,000

Main points to note

- The investment tax breaks are not cash rebates of the asset cost. They are a tax deduction and the cash benefit to you is your own tax rate applied to that amount of tax break. In the 50 per cent tax break example (above) the tax rate is 30 per cent resulting in a $45,000 reduction in the farmer’s income tax bill.
- If you have tax losses, a leasing option may be a more suitable method of financing – especially if the amount of your losses would suggest little tax pain in the coming years. With leasing, the investment tax break is claimed by the leasing company which in turn may pass that claim on to you in the form of a lower interest rate. So if you are in a tax loss situation it may be prudent to consider a lease option and effectively access the investment allowance via a discounted lease interest rate.
- The investment tax break will be claimed in the financial year that installation occurs.
- You should get considered professional advice to determine your tax break eligibility and what financing option is best for your particular situation.

For more information contact Greg on Ph: 07 3221 2416;
Email: gkelly@wpca.com.au

NEW APM SYSTEM SAVES FUEL

“Now is probably not the usual time to think about buying 4WD tractors,” Case IH Marketing Manager Stuart Brown says “but with the advantage of the stimulus package it should make you think again – particularly with the additional fuel savings made possible by the new Case IH APM system.”

Case IH’s newest fuel-saving innovation is the Automatic Productivity Management (APM) system, which is standard on all 2009 model Magnum, Steiger and Quadtrac tractors. The APM system automatically adjusts engine speed and transmission ratio for maximum fuel efficiency and has demonstrated fuel savings from five per cent to 25 per cent (depending on the application).

“The APM system achieves maximum fuel efficiency by automatically adjusting the gear setting and engine RPM, based on ground speed and load,” Stuart explains. “The ‘throttle’ becomes a ground speed control lever while the APM system does the rest.”

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Canola technology systems’ trials

In 2008 five replicated field trials were established across New South Wales, Victoria and South Australia to compare the three commercially available herbicide tolerant canola growing systems; Triazine Tolerant, Clearfield and Roundup Ready. A demonstration site was also run at the Henty Field Days. Research trials were conducted by Pioneer at Howlong, Lockhart Junee Reefs and Yarrawonga. Many farmers, advisors and industry representatives were given the opportunity to view the trials during the 2008 season.

Varieties in the trials were commonly grown varieties for each region with a range of maturities varying from early to mid. The Roundup Ready canola system was demonstrated with the 46Y20 (RR) hybrid, Clearfield was demonstrated with 45Y77/46Y78 and the new 46Y81 (CL) hybrids compared to 44C79 and the new 43C80 (CL) varieties. The Triazine Tolerant varieties were Bravo (TT) and Tornado (TT).

**What we found**

Plant vigour assessments taken four weeks after sowing displayed visual differences between the canola systems. Triazine tolerant varieties were significantly lower in vigour at all sites when compared to the other two canola systems.

Plant vigour is an important trait that helps quicker canopy closure to compete with insects and weeds – particularly in conventional or Roundup Ready canola systems, where there is no residual herbicide available to control weeds in-crop.

Seed size has a large impact on the establishment vigour and plant population and therefore its ability to compete with weeds. Seed size of all varieties in these trials varied from 160,000 seeds per kg to 300,000 seeds.

This variation in seed size produced a close correlation to plant population and the observed vigour advantage of hybrids vs. open-pollinated varieties in all trials.

**Weed control**

Weeds present at the sites included annual ryegrass, wild radish and volunteer cereals with weed pressure at all sites being light to medium. Post emergent herbicide applications were applied at the two leaf stage of the canola for all canola systems. Rates and timing were consistent with district practice and label recommendations.

An advantage of herbicide tolerant canola systems is being able to control weeds; subsequent yield advantages are therefore

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**TABLE 1: Comparative yield and oil at Pioneer Technology System site, Rossbridge, Victoria**

<table>
<thead>
<tr>
<th>Herbicide tolerant system</th>
<th>Yield t/ha</th>
<th>Oil %</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Average</td>
<td>Minimum</td>
</tr>
<tr>
<td>Clearfield*</td>
<td>1.28a</td>
<td>1.13</td>
</tr>
<tr>
<td>Roundup Ready</td>
<td>1.38ab</td>
<td>1.06</td>
</tr>
<tr>
<td>Triazine Tolerant</td>
<td>0.91c</td>
<td>0.83</td>
</tr>
</tbody>
</table>

*Average of 4 CL varieties (ranging from 1.13 t/ha to 1.47 t/ha) Trial CV: 13.91

**Solutions come in all sizes...**

**...so do our systems**

- For comprehensive grain storage and handling systems including design, supply & installation

- Equipment also available includes:
  - MFS commercial silos from 250 through to 15,000 tonnes
  - On-farm agricultural range of storage silos
  - York bucket elevators and conveyors
  - Hutchinson portable tubulator type belt conveyors
  - Hutchinson portable farm augers & swing away augers from 8” to 13”
  - Hutchinson grain pump systems

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**Canada/USA 2009 Farm Study Tour**

North America is undergoing enormous economic and political change and it’s a sure bet that US and Canadian agriculture will need to adapt to this new landscape. In turn, the health of Australian agriculture – not to mention that of the rest of the farming world – is often closely linked to what’s happening ‘down on the North American farm’. This means our 2009 study tour to the US and Canada will be a great chance to see for yourself the opportunities and challenges a changed North America may bring.

Our draft itinerary takes in California, the US breadbasket mid west states including Kansas and Missouri, and the vast Canadian prairies. And we won’t miss out on some of the magnificent sights on offer including:

- The Calgary Stampede;
- The Grand Canyon;
- Sierra Nevadas of California and Yosemite National Park;
- The magnificent Canadian Rockies including Banff, Lake Louise, Columbian icefields;
- The Rocky Mountaineer train; plus,
- Add-on options such as Inside Passage cruises, Victoria Island, Seattle and wilderness experiences in Alaska and Canada, the Oshkosh Air Show.

To express your interest or ask for a copy of the full itinerary please call 07 4659 3555, E: travel@greenmountpress.com.au or visit www.greenmounttravel.com.au
often observed over conventional canola. Due to the low weed pressure at the trial sites, the three herbicide tolerant systems may not have shown their true yield potential as would be displayed in commercial practice (higher weed pressure).

A very difficult season combined with frost and locust damage resulted in the loss of most trials.

At Rossbridge in Victoria, yields of better than 1.0 tonne per hectare were achieved with low sub soil moisture at sowing and a decile 1 growing season rainfall (278 mm).

The top yielding canola at Rossbridge was the new 46Y81 (CL) hybrid. The average yield of the commercial Clearfield hybrids was not significantly different to the Roundup Ready 46Y20 (RR) hybrid tested (Table 1). The Roundup Ready hybrid was 34 per cent or 0.46 tonnes per hectare higher yielding than the TT check varieties. Oil contents were also 1.4 per cent higher (range from 0.5 per cent to 3.2 per cent) in varieties from both alternative canola systems compared to TT canola with the highest oil of 45.4 per cent measured in the new Clearfield hybrid 46Y81 (CL).

High yield potentials indicated by the Clearfield and Roundup Ready varieties in early spring at the Temora trial were not realised. The new early variety 43C80 (CL) topped this trial under the very tight seasonal finish experienced. The variety 43C80 (CL) was also the highest ranked gross margin of herbicide tolerant varieties at the Bernard Hart field site at Junee Reefs. Again oil contents were higher from both alternative canola systems compared to TT canola.

Highest oil content at Temora of 41.5 per cent was measured in the Clearfield variety 44C79 (CL) compared to 37.8 per cent for Bravo and Tornado TT varieties.

For more information:
Kevin Mortorpe, Canola Product Manager, Canberra (02 6242 1979)
David Coddington, Area Sales Manager, Southern New South Wales (0429 995 381)
Rob Wilson, Canola Research Manager, Wagga Wagga (02 6931 7650)
Site co-operators: Syngenta, Southern Farming Systems, NSW Department of Primary Industries.

AT A GLANCE…

• Select varieties (or hybrids where available) with maturity suitable for rainfall and length of growing season;
• Sow early (flexibility to sow dry in no-till systems);
• Use a pre-emergent herbicide for annual ryegrass and wireweed control;
• Use seed size to help calculate correct sowing rate; and,
• Where applying two applications of herbicide; first application should be at cotyledon – two leaf stage, and the second application prior to the six leaf stage.
After speaking to almost 100 farmers in nine countries about how to farm wheat more profitably, Western Australian grain grower Simon Tiller discovered the key was to spend more time inside. This knowledge, garnered last year while Simon was on a Nuffield Scholarship, has already netted him more than $1 million in less than 12 months.

NUFFIELD SCHOLAR BRINGS HOME A MILLION DOLLAR MARKETING LESSON

By Catherine Norwood

Not for the faint-hearted

Simon warns his marketing approach is not for the faint-hearted or the time-poor. The key, he says, is a commitment to marketing.

Simon runs a 10,000-hectare farm business 130 km northeast of Esperance. He produces 20,000 tonnes of canola, wheat, barley and field peas. He says if he can earn an extra $10 a tonne by spending more time studying the market and making better decisions about selling his grain, that’s an extra $200,000 a year. So far, for the 2009 crop, Simon is more than $60 per tonne ahead of the market.

Simon’s Nuffield Scholarship was sponsored by the GRDC and he initially planned to spend his scholarship looking at routes to improved profitability including value adding, feedlotting and using feedlot wastes, grain storage and handling options, and generally entering the grain value chain.

But last year, in discussions with almost 100 farmers in nine countries – New Zealand, Ireland, Scotland, England, France, the US, China, Canada and the Philippines – he identified time spent delving into various grain marketing options – rather than sitting on the tractor – is paying dividends and making his grain-growing enterprise more profitable.

Before travelling overseas Simon had appointed one of his staff as manager in his absence and upon returning he made the position permanent, to free up more of his own time. He has also set up new banking arrangements and a trading account that allows him to more effectively enter the grain trading market, including the futures market.

Arriving at a reasonable return

Simon uses a detailed business plan to determine what his crop inputs will be and how much he needs to make per tonne to achieve a reasonable return. He uses the average yield for the past five years and total budgeted cost of inputs for the current crop, plus 20 per cent, (preferably 25 per cent), to set a price for his wheat and canola. He no longer sells his crop into market pools because the pools simply don’t offer the price he needs.

Instead he takes whatever the cash price is when he delivers his grain to local traders at harvest, and uses grain futures to ensure returns in line with his pre-determined ‘reasonable return’.

“We first tried hedging with futures in 2006, and got burned in 2007 – we were given some bad advice and we weren’t proactive enough when the market started to improve. Since coming back from my Nuffield travels I’ve taken more time to investigate the options and found an independent advisor I trust, and we’re starting to get things right.”

Simon says if the price of grain goes up, and wheat or canola is actually selling for more than the value of his grain futures on the Chicago Board of Trade he loses money on his futures – but makes it up when he sells his crop. If the price of grain falls during the season, he will get less for it when he delivers his crop, but his futures, contracted at the higher price, will make up the difference.

“This way I can maintain the income from my crop at the level I need to remain profitable. If I can’t buy futures for a price that covers the cost of my inputs and a profit margin it is simply not worth growing the crop.”

Simon buys futures’ positions for the equivalent of 80 per cent of his wheat crop and 70 per cent of his canola crop one, and sometimes two, years in advance.

Simon says one of the benefits of marketing your own grain is that you can tailor your strategies and level of risk to suit your business, and take into account factors such as debt levels or rainfall reliability. But it is also essential to have a licensed financial advisor, and to seek information and advice from a number of different sources. Relying on any one person too much is just dangerous, he says.

Grain market deregulation

He believes the deregulation of grain markets in Australia will make it more important for farmers to actively engage in market mechanisms such as futures to improve their profitability, although it takes time and effort to really understand how the markets work.
Simon suggests anyone new to futures markets and hedging start with a few small trades to build their confidence, rather than leaping in.

One issue Australian farmers face in doing their own marketing is that most of the advice on selling grain comes from consultants who have ties with the grain buyers. “I don’t think the grain traders are really the best people to get advice from about when to sell grain,” he says. “In Europe and the UK independent consultancies are more well-established than they are here. I hope that we will see more independent advisors setting up in Australia.”

Simon says his Nuffield Scholarship was a great opportunity to see what is happening globally in agriculture. It introduced him to a network of the world’s leading farmers and provided opportunities he would never have had travelling alone.

More information: Simon Tiller on 08 9078 7075 or E: simon.tiller@bigpond.com

R&D VITAL TO SUCCESS

Simon has packed plenty into his 26 years, including a move across the Nullarbor from South Australia to Western Australia nine years ago.

The move from 600 hectares in SA to 7000 hectares in WA, generated largely by a crippling drought, was challenging – but it’s how Simon claims he learned all about no-till and farming sandy, acid soils.

He acknowledges research and development is a real key to successful modern farming.

“Although we do a fair bit ourselves on-farm, we simply can’t do it all, so we rely very much on outputs from R&D efforts, including those supported by GRDC,” Simon said.

“I value the work of technology developers too and although I want to keep a cap on my expenses, I acknowledge companies must also make a profit to continue to invest in product development and R&D.”

Simon buys futures’ positions equivalent to about 80 per cent of his average wheat yield over the previous five years.

NUFFIELD APPLICATIONS CLOSE JUNE 30

Applications for the 2010 Scholarships are now open, with 20 scholarships valued at $27,000 each, sponsored by a range of leading agribusiness and primary producer organisations.

Scholars take part in a compulsory six-week Global Focus program that includes Canada, the US and UK and may also include the Philippines, Brazil, China, France and Ireland. This is followed by a further 10 weeks of international travel as part of each scholar’s individual study tour.

Scholars are selected for their farming and leadership capabilities, and potential to make a valuable contribution to Australian agriculture. Applications close on June 30, 2009.

Application forms are available from Nuffield Australia on 03 5480 0755, via enquiries@nuffield.com.au, or from the website www.nuffield.com.au. Successful scholars will be announced in October 2009.

Discussion of the benefits of R&D at the 2009 GRDC supported WANTFA conference were (L to R) GRDC Western Panel Chairman, Neil Young of Kojonup, Simon Tiller and WANTFA Committee Member and former GRDC Western Panel member, Deane Aynsley of Beverley.
The no till, no sheep and ‘knowledge’ farming system

By Peter Norris, Agronomy For Profit, Geraldton WA

No till, no sheep and ‘knowledge’ is the name I have given to our emerging farming system in Western Australia’s northern wheatbelt. It is the system that is used by almost all of the farm businesses that employ my agronomy services. This developing farming system has a break-even rainfall on sand soils of around 150 mm – and on heavier soils around 175 mm. It is a vast improvement on production systems even those from the recent past.

What is the no till, no sheep and ‘knowledge’ farming system delivering?

**NO TILL**

In 1993 Western Australian No Till Farmers Association (WANTFA) decided, after much debate, to define ‘no till’ as ‘establishing crops with incomplete soil surface disturbance’. A pretty wide scope but this covered all of the techniques that were being used. Zero till is with disc seeders that disturb very little of the soil surface as they place seed and fertiliser.

No till crop establishment gives a huge number of benefits. The first is less soil erosion compared to tillage. WA grain growing areas had significant water erosion soil loss leading up to the change to no till. Wind erosion was also a much bigger problem in the past.

Crop residues are retained on the soil surface. This reduces evaporation and protects small plants from harsh weather events. Heavy stubble cover can reduce evaporation by as much as 50 mm during the season. This can give significant yield improvements.

Knife point and press wheel seeding systems have allowed much higher trifluralin rates to be used. This has been instrumental in getting back on top of ryegrass in the northern wheat belt. This is simply where the tine moves the treated soil into the ridge away from the furrow where the seed is placed.

This, and other techniques, have lead to a 98 per cent reduction in ryegrass numbers over eight years.

Row spacing generally used in WA range from 17 to 37 cm (or 7 to 15 inch), with 85 per cent of my clients in the North between 22 and 30 cm (or 9 and 12 inch), row spacing.

**NO SHEEP**

The economics with sheep do not seem to stack up any more in WA. The economics in our part of the world are based on only three to five DSE per hectare which could only turnover $120 to $150 per hectare. Even 0.5 tonnes per hectare of canola is currently at over $250 per hectare. There is not the exposure to profit potential with livestock.

There are only three places we can potentially justify sheep:

- Unarbeit country;
- Severe frost prone farms; and,
- Very acid low production eastern wheatbelt ‘wodjil’ soils.

Outside of these areas it is very difficult to justify sheep.

The damage their footwear does to soils is immense – particularly our sand soils that are exposed to wind erosion by grazing. On wet heavy soils they also plug the soil and greatly reduce water infiltration.

Grazing removes cover which is essential for improved rainfall infiltration – and then reducing evaporation once you have the moisture in the soil.

Cattle seem to do less damage. Plus they usually make you get to know your neighbours better and they taste (the cattle) better!

No sheep on farm also adds about 300 extra hours to the cropping work or holidaying program.

‘KNOWLEDGE’

Timing is usually the difference between good farmers and bad farmers.

The three costs in crop protection are:

- Yield loss;
- The remedy; and,
- Monitoring.

**Weed management**

Integrated Weed Management means weed numbers are on the decline. Those farmers who creatively employ IWM are growing better crops due to very low weed numbers. Having a solid IWM program on farm allows tactics such as dry sowing to be employed with the confidence of not having a crop failure.

IWM is one of the key planks of this farming system. Pressure is still applied to the weed populations by herbicides but more is applied by non chemical control methods.

**Good strategic and tactical decision makers**

Good rotational, soil health, machinery replacement and other strategies are in place in this system. The good farmers also make the right tactical decisions such as spraying out a poor performing broad-leaf crop in dry seasons and dry sowing some paddocks when the break is late.

These tactics generally have big benefits in overall long term profitability.

**Weather watchers and plan programs ahead**

Knowing it is NOT going to rain is often as important as knowing that it is going to rain. Work is planned around expected weather conditions as a main driver.

**Nutrition**

The nutrition ‘bucket’ on these good farms is kept full. Occasionally in dry years or extreme fertiliser prices, the fertiliser bank will be used. In the vast majority of cases more nutrients are being applied than removed. This also helps out with the building of organic matter in the soil.

Potassium nutrition and addressing soil acidity are big factors in added performance. Some growers also grow larger stat-
ured varieties to keep the stubble levels up and plenty of ‘soil food’ going back onto the soil.

**Disease control**

These growers are quickly onto any crop problems and address them as early as possible. Leaf disease is kept at bay with variety choice and triazole fungicides. The subsequent yield and grain quality benefits are now well established.

**Crop rotations**

Some rotations are set in concrete and many are flexible depending on the season. Those set in concrete tend to have a mix of country that suits growing of lupins, canola and wheat.

- Common rotations:
  - Barley/lupin/wheat/canola (agronomically ideal in medium and high rain areas).
  - Wheat/lupin/wheat/canola (is also common).
  - Lupin/Canola/wheat/wheat (gaining some more support).
  - Canola/wheat/canola/wheat (will probably be more common in the higher rainfall areas).

In low rainfall areas the rotations have many more wheat phases due to the higher risk of broadleaf crop failure.

- A typical rotation might be:
  - Canola/three wheats/lupin/three wheats.
  - We also have the odd paddock of continuous wheat in these drier areas.

- Further south there are areas where long term rotation trials have had continuous malt barley as the most profitable (non) rotation.

The key points are that there are no rules and you can choose crop sequences to maximise profit and/or to solve a weed problem.

**Trying to build soil fertility**

Most growers are achieving this through no till and plugging all of the holes in the nutrition bucket. The yield potential of this farming system is huge and growers need to be very aware of how many nutrients they remove in high production years.

**THE FUTURE**

**Weed seeker technology**

This technology will reduce overall herbicide costs by allowing targeting of weeds or weed areas. A contractor is setting up in the Mingenew area and should be operational in 2009.

**Shielded sprayers**

They may prove useful but herbicide tolerant GM crops may negate the need for shields.

**Precision Agriculture (PA) and Variable Rate Technology (VRT)**

EM38 and radiometrics technology will be very good for zoning off heavy soils and ameliorating poor performing areas. This allows changes in input levels such as fertilisers and soil ameliorants and will change the cost structures in paddocks.

The problem here is which way to go?

- Do you add inputs to poor performing country to get it to yield better or do you reduce inputs on the lower performing parts of the paddock and use them on the better performing areas?

  Great care is needed with this technology to make sure that you do not add to your overall risk profile when you move some inputs such as nitrogen.

  Precision Agronomics Australia have demonstrated $17 per hectare per year benefits in the Esperance area of WA.

**Tramline farming**

Improvements to the ‘road and root bed’ system will give huge benefits. The auto steer systems have given much lower overlap losses. Although this system is being employed on farms many still need a few good crops to match all of their machinery up.

**GM crops**

GM technology will be brilliant. Herbicide tolerance, although good, will not be the biggest advance that this technology will deliver.

Frost tolerance, acid soil tolerance, drought tolerance, and salt tolerance will be of much greater value to growers.

And I reckon that this technology can play a big role in pulling the world out of the current global recession.

**Permanent ridges and furrows**

RTK 2 cm steering systems may allow this to develop. I have not yet seen anyone do this but it would be brilliant. This revolves around creating ‘curtains of fertility’ and growing the crop only above the curtains. This concept would more likely suit lower rainfall areas but it is still some time off. I am itching for someone to have a crack at this concept. But we are getting close.

**Improved soil ameliorant targeting**

Gypsum, lime, soil wetters and so on, to increase overall farm productivity...
Dynamic crop sequence trial: An Australian first

By Paul Carmody, Future Systems Analyst, DAFWA

A Dynamic Crop Sequence (DCS) trial at Katanning in Western Australia’s Great Southern region, is the first of its kind for the Australian grain industry. The trial tests up to 100 different crop sequences in a crisscross trial design to address the question of break crop effect (see photos opposite).

According to Raj Malik, Research Officer for the Department of Agriculture and Food, WA based in Katanning, the only trials in the past that came close to this concept were trials by CSIRO’s John Kirkegaard. John looked at the effect of biofumigation properties of mustard and canola on the following cereal crop in south central NSW.

Why do the DCS trial?

Now in its second year the DCS trial is investigating the reasons why farmers do or don’t get a break crop effect from crops like canola, field peas, lupins or oats in dryland farming systems of southern Australia.

The trial site covers over four hectares. Crop treatments in 2008 (see Table 1) are crisscrossed with the same treatments in 2009 and 2010.

Solving patchy problems

Issues such as shallow gravel ridges that damage seeding gear will be dealt with. There is one machine operating in WA (from South Australia) that is profile grinding these hard areas and ‘rotary grinding’ them down to a depth of around 250 mm. This solves machine damage issues and adds these usually productive areas to the arable hectares list.

‘Voodoo’ science

At the 2009 DAFWA/GRDC Crop Updates Dr Doug Edmeades (see www.agknowledge.co.nz) spoke about science being under threat because of the modern philosophy of political correctness which infers that all opinions are equal.

The problem here is that they are not. The scientific methodology is the only way you can gain confidence about a theory or a product. If it is rigorously tested, in appropriately designed trials, with untreated checks and the results are published in a reputable peer reviewed journal – then you have confidence in it.

Organic food, the man made climate change debate, the banning of herbicides, the GM crop debate and holistic medicine are a few areas where rigorous science is being pushed aside.

Over time there have been many questionable products that have hit the agricultural market and are a flat out rip-off. You need to push promoters of these products for the replicated trial results. Buyer beware.

Those of us with a vested interest in the value of evidence based sciences (which is everyone!) need to defend the scientific process with vigour and yell down those who erode the place of the discipline of science.

TO SUM UP

The no till, no sheep and ‘knowledge’ farming system has changed the landscape dramatically. The system is more robust financially, has stood up to resistant weed pressure and can better weather dry seasons. Growers need to look at the risk profile of their business and answer a few questions:

Do you put the blinkers on and rest on this knowledge and just seed everything from April 20 each year? Look at the long term annual rain for your area and see what your probability is of a profitable crop. If you are happy with the odds – why not just go seeding? And this is just what many are doing with great success.

Contact Peter on pfp@westnet.com.au

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TABLE 1: Treatments for the dynamic crop sequence trial at Katanning, WA

<table>
<thead>
<tr>
<th>Treatment 2008</th>
<th>Treatment 2009 – Cross sown on 2008 treatments</th>
<th>Treatment 2010 – Sown over entire site</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Wyalktachem wheat with Jockey</td>
<td>Wheat plus Jockey</td>
<td>Wheat</td>
</tr>
<tr>
<td>2 Wyalktachem wheat without Jockey</td>
<td>Wheat minus Jockey</td>
<td>Wheat</td>
</tr>
<tr>
<td>3 Buloke barley</td>
<td>Barley</td>
<td>Wheat</td>
</tr>
<tr>
<td>4 Bravo canola</td>
<td>Canola</td>
<td>Wheat</td>
</tr>
<tr>
<td>5 Carrolup oat</td>
<td>Oat</td>
<td>Wheat</td>
</tr>
<tr>
<td>6 Carrolup oaten hay</td>
<td>Oaten hay</td>
<td>Wheat</td>
</tr>
<tr>
<td>7 Kaspia field pea</td>
<td>Field pea</td>
<td>Wheat</td>
</tr>
<tr>
<td>8 Jennabillup lupin</td>
<td>Lupin</td>
<td>Wheat</td>
</tr>
<tr>
<td>9 Green manure (Oat 50 kg/ha and Morava vetch 25 kg/ha)</td>
<td>Green manure</td>
<td>Wheat</td>
</tr>
<tr>
<td>10 Fallow</td>
<td>Fallow</td>
<td>Wheat</td>
</tr>
</tbody>
</table>

Raj Malik and Project Manager Peter White (DAFWA) at the Dynamic Crop Sequences trial site at Katanning.
2009 to establish 100 combinations of crop sequences for the final year of wheat to be sown across in 2010.

It is a large investment into understanding what the effects are of different crop sequences on wheat for – in the Katanning region – duplex soils of the southern wheatbelt. The trial is also unique because for the first time, it compares oaten hay and a manure crop in crop sequences. This ‘effect’ has been largely overlooked by past crop rotation studies.

The trial is part of a GRDC project co-funded by the DAFWA which will examine the place of break crops through bio-physical and whole-farm economic analysis. The work included a review of past research on break crops and factors that influence their use in rotations. This review has helped to formulate such an unusual trial.

Other DAFWA research staff assisting in managing the trial are Mark Seymour, Senior Research Officer and Pam Burgeiss, Technical Officer both based in Esperance.

The Katanning trial was established in 2008 with 10 different treatments (see Table 1) being sown in 10 m wide x 100 m long strips which have now been crisscrossed with the same mix of crops in 2009 before a final treatment of cereals in 2010.

A second GRDC and DAFWA supported trial has been established at Wongan Hills in the central wheatbelt to help our understanding of break crops in future farming systems in that type of environment.

**What are we measuring?**

Some of the elements being measured in the DCS trials to quantify the effect of one crop on the performance of the following crop include:

- Water use;
- Disease flow;
- Yield stability;
- Weed carryover;
- Residue impact;
- Economics; and,
- Soil health.

The trial design allows for many combinations of crops to be followed by wheat in the one environment. This provides a fair comparison of the various crop sequences.

See Southern Focus for the second article in a DAFWA series detailing break crop case studies.

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**BREAK CROP BENEFITS INCREASING OVER TIME**

According to Mark Seymour, Research Officer for DAFWA, there has been research in the past throughout WA to determine the break crop effect of lupin on sandy soils, field peas on heavy soils and canola on a range of soil types.

“Over 150 experiments have been conducted across the wheatbelt since the 1960s to determine the rotation effects of leguminous or oilseed crops in a cereal based rotation,” says Mark.

“Most of this work has been reported in the context of a yield improvement to following wheat crop compared to a continuous cereal rotation. This can range from no effect to a 20 per cent benefit depending on the situation.

“But with the advent of no-till and the availability of more effective grass herbicides, the actual magnitude of the yield advantage has increased. For example, since 1990 wheat after lupin yields are actually larger than in trials conducted before 1990 (see Figure 1),” Mark points out.

“Nowadays farmers also have access to more effective fungicides to control both leaf and root diseases in cereals, and they routinely apply fertilisers throughout the growing season at generally higher rates (in total) than 10 years ago. Under these circumstances you might expect the yield benefit from a break crop to now be lower.

“This is one of the reasons for revisiting the crop sequence trial – to help answer the question farmers ask: “What is the best crop to sow after the last one or two?”

“The DCS trial approaches this question in a different way. In the third year we can look at the effect of 100 different crop sequence combinations leading up to the third year wheat crop,” Mark said.
It’s natural climate change, stupid!

By Professor Bob Carter, Marine Geophysical Laboratory, James Cook University Townsville

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amously, during the 1992 US election Bill Clinton’s staff hung a sign on the wall of his campaign office that read, “It’s the economy, stupid!” It was no coincidence that Mr Clinton won the subsequent election, because focusing on real issues is what real leaders do.

In contrast, Australia currently possesses leaders of both its government and opposition who are lost in an imaginary world of virtual reality about one of the most important public issues of the day. They need a new and different sign on their desk, namely: It’s natural climate change, stupid!

For, whether it reflects simple ignorance or the sophisticated seeking of political advantage, and it must be one or the other, both our prime minister Mr Rudd and our opposition leader Mr Turnbull have declared themselves in favour of the introduction of carbon dioxide taxation in order to help ‘stop’ a wholly imaginary human-caused global warming.

Speculative, and wrong, models

Their beliefs are supported only by speculative computer climate models already known to be wrong, and they will implement an emissions trading system (ETS) at their own political peril and to the great detriment of the Australian people. Get this:

• First, there has been no recent global warming in the common meaning of the term, for world average temperature has cooled for the past 10 years. Furthermore, since 1940 the Earth has warmed for 19 years and cooled for 49, the overall result being that global average temperature is now about the same as it was in 1940.

• Second, this lack of overall warming over the past 68 years happened despite an increase in atmospheric carbon dioxide of more than 20 per cent – which is actually no surprise, because, notwithstanding that it is a greenhouse gas, the increase in the warming effect of carbon dioxide beyond 1940 levels is diminishingly small.

• Third, by planetary accident, in comparison with most of the Earth’s geological history we live today in a world that is in a state of carbon dioxide starvation, especially for optimal plant growth – just ask the commercial tomato growers who use enhanced levels of carbon dioxide in their greenhouses to expedite crop growth.

• Fourth, experience in Europe shows emissions trading markets are unstable, and that a carbon dioxide tax is ineffective as a tool for reducing emissions at any reasonable price level.

Overall, therefore, Mr Rudd’s planned emissions trading scheme suffers from the double indignity of being a non-solution to a non-problem.

Confusing science with politics

Against this background, the commentary on ‘global warming’ in the general press consistently and conspicuously misses the point, not least because most journalists and editors are innocent of knowledge of the workings of science and cling to a naive belief that scientific matters can be determined by authority or consensus – thereby confusing science with politics.

Politics may well be about consensus, as determined by who can shout the loudest, who has the most money to buy media advertising or to pay lobbyists to influence affairs on their behalf, and who can thereby win the most votes – but science is not.

Science is about testing hypotheses, and the hypothesis of the day – that dangerous global warming is being caused by human carbon dioxide emissions – has been tested repeatedly and found to be invalid, inter alia by the information presented in the previous paragraphs.

Frightened by science that they do not understand, anxious not to offend the powerful and intimidatory Green lobby, and with a climate eye always open for scare stories that will help sell their product, media commentators therefore concentrate on the politics of the matter.

Natural climate change

“Great,” I hear you say, “so now I can just relax and forget about climate change then?” Not so fast. The greatest damage that has been inflicted by those whipping up the imaginary threat of human-caused global warming is that the hysteria has overwhelmed mature consideration of the much greater and proven threat of natural climate change.

There is irony as well as irresponsibility here. It is that the type of cooling (not warming, note) that the globe has experienced since around the turn of the 21st century, which some leading scientists predict will become significantly more intense because of our currently quiet sun, is by its very nature more damaging to human activity and health than an equivalent amount of benign warming would be.

The prescribed remedy for those who might be inclined to doubt this is a study course in the history of the Little Ice Age, which extended from the late 13th century to the mid-19th century.

With the arrival in August 2005 of Hurricane Katrina, Americans were given an abrupt reminder of the danger of natural climatic events. For despite acres of newsprint to the contrary, no substantive evidence has emerged that this was other than a natural storm. And now it’s Australia’s turn.

In February this year, and, given the government’s ETS timetable, bang on cue to enlighten our politicians about the difference between real and imaginary climatic events, Mother Nature provided us with a reminder of the awesome power that lurks within her natural furies.

In the north, monsoonal downpours of more than 1.2 metres in seven days caused large parts of tropical Australia to be flooded; rivers rose up to 12 metres above their normal level, and 62 per cent of Queensland (580,000 km²) was designated as a disaster area. At the same time, large areas of Victoria were ravaged by firestorms that razed areas greater than 4500 km², in the process destroying more than 2000 houses, leaving more than
7000 people homeless and causing more than 170 deaths.

‘Weather’ and ‘climate’ are conventionally distinguished as daily-to-annual and 30-year-averaged meteorological measurements, respectively, but this is a statistical convenience rather than a scientific truth. In reality climate processes – which are dynamic, non-linear, and a manifestation of heat transfer and distribution throughout two interconnected, turbulent, fluid envelopes (the ocean and the atmosphere) – occur over all time scales from seconds up to millions of years in length.

In this context, the two recent natural disasters in Australia, far from being unusual, represent typical climatological hazards such as planet Earth has ever been heir to.

All competent scientists accept that global climate has always changed, and always will; that human activities (not just carbon dioxide emissions) definitely affect local climate, and have the potential, summed, to measurably affect global climate; and that carbon dioxide is a mild greenhouse gas.

The real debate

The true scientific debate, then, is about none of these issues, but rather about the sign and magnitude of any human global effect, and its likely significance when considered in the context of natural climate change.

Two main groups of facts are relevant:

• The first is the available instrumental measurements of global temperature for the last 60 or so years. Despite quality control problems, especially with data collected by the ground thermometer network, three separate methods of temperature measurement yield the same result. The methods are ground thermometers, weather-balloon-mounted radiosonde sensors, and satellite-mounted microwave sensing units.

And the result that they agree on is that little if any overall warming has occurred since at least 1958 (the starting date for the weather balloon dataset). Furthermore, the minor decadal-scale changes recorded in these datasets fall well within the known previous natural rates and magnitudes of temperature change.

On top of these instrumental measurements, proxy estimates of the temperature of the past 150 and more years from around the world, for example tree ring analyses, do not record evidence of untoward warming in the late 20th century.

• The second important fact relevant to the climate debate is that Earth is a dynamic planet. This is manifest in changes in atmospheric composition, atmospheric aerosol load, global and regional ice volume, the frequency and intensity of storms, patterns of precipitation and drought, sea level and the ranges or abundances of individual organisms and their ecological habitats.

The press, faithfully repeating what is fed to them by Green lobbyists, assert that these changes are controlled by, or linked to, human-caused global warming.

These matters are, of course, proper topics for concern, and all are being subjected to intensive research. But no empirical study has yet established a certain link between changes in any of these things and human-caused global warming.

Instead, the changes simply reflect that Earth’s systems are constantly evolving. Consequently, changes occur in all aspects of local climate, all the time and all over the world, and geological records show that climate also changes continually through deep time.

Change is what climate naturally does, and the ecologies of the natural world change in parallel.

To summarise, the indirect evidence advanced for human-caused climate change is all equally consistent with a natural origin. Since the establishment of the IPCC in 1988 several thousand scientists have spent more than US$50 billion looking for evidence of human-caused warming without avail. No direct evidence exists for a worrisome magnitude or rate for human-caused global climate change over the past 50 years.

Emissions trading

In such circumstances, it is surely remarkable that the Minister for Climate Change, Penny Wong, on behalf of the current Labor government, and at a time when the globe is cooling, remains so determined to implement an ETS in Australia. Equally remarkable is that the mainstream Australian media continue to evangelise on behalf of the global warming industry and, by and large, ignore the advice of scientists who are independent of the main climate lobby groups.

The main issue now is surely not about whether a tax or trading system is the superior economic instrument, as endlessly discussed, but about why there is any need for a carbon dioxide levy in the first place.

The problem that confronts us still is the powerful influence of the guilt-based misinformation that compliant media reporters have remorselessly fed the public about global warming, to the point that public opinion is said to demand government action to “stop climate change”.

It is entirely unsurprising that politicians have thereafter gravitated towards regulatory schemes that will yield them more tax income, with business interests swinging in behind with their own various ‘solutions’ that will make them money too.

More generally, the carbon dioxide taxation ambitions of our politicians have been egged on by the many self-interested groups who, one way or another, see themselves as benefiting from emissions trading legislation. The most powerful are the large environmental NGOs, whose political generals nightly display their ignorance of science, unchallenged, on our television screens.

But close behind come various industry groups, especially the alternative energy providers and the financial services industry (think Enron and Lehman Brothers), whose members so skilfully masterminded the economic disaster that presently surrounds us. Just think of the fast money that is going to be made by ticket-clippers manipulating a carbon dioxide derivatives scheme based upon trading in a commodity that is odourless, tasteless, colourless, for most practical purposes unable to be measured, and never changes hands.

Meaning, of course, that in most cases those oh-so-reliable and incorruptible computer projections will be used rather than...
measurements. Have you ever tried to audit a complex computer model?

Emissions trading legislation, despite its current popularity with governments, including ours, represents an ineffectual response to speculative global warming only.

It does not comprise, and nor is it even a desirable part of, an adequate national climate policy, and neither would be a direct carbon dioxide tax. Rather, policies are needed by all countries that will improve our ability to recognise and adapt to real (that is, natural) climate change irrespective of its causation – circumstances dictate that these strategies be adaptive.

A former New Zealand environment minister, Simon Upton, recently wrote:

"It is pointless to apportion blame. But for the sake of environmental credibility and business certainty, the plea has now surely to be that our legislators try to build some constructive middle ground ... Anyone who has studied the [climate change] issue in good faith knows that there are no certainties and that it is a risk management issue."

Mr Upton is surely right, yet his message is ignored by our current political masters, who continue to pursue the alarmist agenda of global warming extremists even to the point of inflicting yet more swingeing (and pointless) damage on an already teetering economy.

**Risk appraisal**

It follows from the earlier discussion that dealing with future climate change, both natural and possibly human-caused, is primarily a matter of risk appraisal – and those risks vary in type and intensity from geographic place to place. Hence every country needs to develop its own understanding of, and plans to cope with, the unique combination of climate hazards that apply to it alone.

The idea that there can be a one-size-fits-all solution to deal with future climate change, such as recommended by the IPCC, fails entirely to deal with the real dangers.

Natural climate changes of all types are going to continue to affect our planet, and from time to time these changes will wreak human and environmental damage. Future changes will include cooling trends, warming trends and sudden step-events.

Extreme weather events and their consequences, and prolonged inconveniences such as droughts, are natural disasters of similar character to earthquakes, tsunamis and volcanic eruptions. With our present state of knowledge, they can neither be predicted far ahead nor prevented once they are under way.

The existence of such natural hazards is the prime reason why civil defence agencies exist. Throughout the world, such agencies consist of a mix of national and regional organisations and volunteer groups.

World best-practice in emergency civil defence may lie with our near neighbour, New Zealand, which has established a widely admired GeoNet organisation to advise on and manage environmental hazards. GeoNet provides other authorities and the public with accurate, evidence-based information about hazards like earthquakes, volcanic eruptions, tsunamis, landslides and floods.

It is time to move away from ‘he-says-she-says’ arguments about whether human carbon dioxide emissions are causing dangerous warming, and on to designing effective policies of hazard management for all climate change, based on adaptation responses that are tailored for individual countries or regions.

For the key issue on which all scientists agree is that natural climate change is real, and recent history exemplifies the substantial human and environmental damage that it can cause.

**Scare campaign**

The current public ‘debate’ on climate is not so much a debate as an incessant and shrill campaign to scare citizens into accepting dramatic changes in their way of life in pursuit of the false god of preventing dangerous global warming. Furthermore, this ‘debate’ is consistently misrepresented by the media as being between morally admirable ‘believers’ and morally challenged ‘deniers’.

Such shallow moralities have nothing to do with science, which derives its considerable moral and practical authority from the objective use of facts, experiments and analytical reasoning to test hypotheses about the natural world.

The global warming issue has become big business indeed for bureaucrats, politicians and business, as well as for scientists and environmental NGOs. It has been estimated that Western countries alone are currently spending at least $5 billion annually on global warming-related research or policy formulation. This buys a lot of science and influences a lot of adherents.

Doug Hoffman and Allen Simmons (in *The Resilient Earth*, 2008) estimate that currently the United Nations alone funds 60,000 projects that deal with (human-caused) climate change. The ascendancy of President Obama to his Washington throne has been greeted by a more than 300 per cent increase in global warming lobbyists to Washington, with 770 companies and interest groups hiring 2340 lobbyists to influence federal policy on climate change in the past year.

**No empirical evidence**

All of this activity, and much more besides, is predicated upon the supposition that human carbon dioxide emissions are causing dangerous global warming. Instead, the hard reality is that after 20 years of intensive research effort, and great expenditure, no convincing empirical evidence exists that the human effect on climate (which is undeniable locally) adds up to a measurable global signal.

Rather, it seems that the human global signal is small and lies submerged deeply within the noise and variability of the natural climate system.
IPCC and dead parrots

The IPCC’s Plan A, therefore, is a dead parrot. For “greenhouse gas reduction”, by any means, becomes an irrelevancy when it can only deal with as-yet-unmeasured, human-caused global warming, at a time when the globe has been cooling for 10 years.

But just as the ‘science’ that is cited in favour of dangerous human warming caused by carbon dioxide emissions shows all the hallmarks of orchestrated propaganda, so too the real science shows beyond doubt that the wide array of extreme natural events – which include climatic warming trends, cooling trends, step-events, heat waves, droughts, cyclones, floods and snowstorms – pose great dangers for humanity.

Australia therefore now needs a Plan B, which is the introduction of adaptive policies to deal with natural climate change, in place of the government’s current expensive, inefficient and ineffectual plans to “prevent human-caused global warming”.

The failure of both Mr Rudd and Mr Turnbull to respond to this need by confronting ecosalvationist hysteria about imaginary global warming, and at the same time to deal sensibly with the real threat of natural climate change, now bids fair to undermine their leadership positions.

A national climate policy that improves our ability to recognise, manage and adapt to natural climate change and events, as could be met by the creation of a HazNet organisation, is an urgent necessity, and would cost but a fraction of the mooted ETS. To boot, contingent damage to the economy, energy systems, the standard of living and the world food supply would be avoided.

And, by their very nature, strategies that can cope with the dangers and vagaries of natural climate change will readily cope with human-caused change too, should that ever manifest itself.

Why is it so difficult for Australia’s major political parties to discern this obvious truth?

This article is based on a paper given at the Heartland International Climate Change Conference, New York, in March this year.

Further information relevant to the issues discussed can be found on Bob Carter’s website: http://members.iinet.net.au/~glrmc/


Go to www.quadrant.org.au for more articles and subscription details.

Quadrant magazine is the leading general intellectual journal of ideas, literature, poetry and historical and political debate published in Australia.

Next year will see New Holland celebrate 35 years since the release of the world’s first rotary combine – the twin rotor TR70. Over this extended period, New Holland has continually developed and enhanced this unique, highly productive, twin rotor threshing and separation concept. The culmination of this is the incorporation of the very latest twin rotor and combine harvester technology in the new CR9080.

Tony Peters, New Holland Product Manager for Combine Harvesters said: “New Holland remains the only manufacturer in the world to have the twin rotor combine harvester. There are a number of single rotor combines, but only one twin rotor.

“The threshing concept has stayed true to the basic principles of grain on grain threshing and high centrifugal force. This technology developed 35 years ago, continues to be recognised as the best in class separation system.

“Kondinin Group tests in 2007 of four leading brand combine harvesters,” Tony points out “resulted in New Holland’s CR being deemed by the testing team as the leader of the pack in terms of clean grain sample, lowest grain loss, cabin comfort, and overall performance.

“The current range of CR9000 combines continues this pedigree with a three model line-up including:

- The class 7 CR9060 – maximum power of 306 kW (410 hp) @ 2000 rpm;
- The class 8 CR9070 – maximum power of 345 kW (462 hp) @ 2000 rpm; and the,
- Range leading class 9 CR9080 – maximum power of 390 kW (523hp) @ 2000 rpm.

The harvesting productivity of three machines

New Holland’s flagship, the CR9080, was introduced in the 2008 season. Ross Stone, a grain grower from Quairading, Western Australia, put a new CR9080 through its paces. Ross traded two TR model combines for the new machine fitted with a 12.8 m (42 ft) New Holland draper front.

Records kept by Ross show that the performance of the C9080 has been second to none. The CR9080 achieved a harvesting productivity equivalent to the use and capacity of three TR98s.

The new CR980 from New Holland has sold out for the current season but orders for 2010 delivery are being taken now. This will allow growers to take advantage of the generous temporary tax breaks currently on offer from the federal government.

Apart from considerably less ownership costs, Ross also calculates direct savings in labour and fuel consumption.

The fuel saving alone was $700 per day, brought about by having power in reserve. The secret to the CR9080s economical performance is to not operate the combine at full power.

Ed Johnson, New Holland’s Sales and Service Support Manager in Western Australia was on site when Ross was harvesting a crop of lupins.

“Because of the seasonal conditions, the crop contained a significant amount of green wild radish,” Ross said. “At moisture levels of 19 to 22 per cent, the CR9080 harvested 36 tonnes per hour of lupins at about 80 per cent power. And the CR handled the green material with ease, producing an acceptable sample.”

Ross harvested 6000 hectares of wheat, barley, canola and lupins in 2008 and he attributed a six figure saving in grain loss to the performance of his new CR9080.

Tony Peters points to the fantastic performance of the CR9080 in 2008 as a major reason for a total sell-out of units in Australia in 2009.

But New Holland are now taking orders for the 2010 delivery season. This will allow growers to take advantage of the temporary tax breaks currently on offer from the federal government as part of the economic stimulus strategies.
GRDC reviews variety trials

Commercial scale variety trials vital to the future of the grains industry will be improved following an extensive consultative review of the National Variety Trials (NVT) by the Grains Research and Development Corporation.

The NVT program is managed by the Australian Crop Accreditation System Limited (ACAS) under a service agreement with GRDC and involves more than 580 trials sown at over 250 locations each year. Crops tested include wheat, barley, triticale, oats, canola, lupins, lentils, field peas, faba beans and chickpeas.

Dr Juan Juttner, GRDC project manager pre-breeding says the review – planned at the establishment of the NVT in 2005 – incorporated more than 360 group and individual submissions.

“Consultation with NVT stakeholders from across the industry has been highly beneficial to the future of the trials,” Juan said. “Every group or individual who provided a submission or was involved in the review received a summary of the review’s outcomes. The summary is also available for download from the GRDC website.

“Many comments indicated a need for a formalised mechanism for stakeholder involvement in NVT operations,” Juan said. “An advisory committee system across Australia will now be established to provide input into the trials to ensure the NVT system continues to improve its delivery of key data to stakeholders.

“The review helped identify ways to strengthen and expand the role NVT plays in providing reliable information about the performance of new varieties to growers, consultants and breeders.”

Separate committees will be established for wheat, barley and coarse grains, canola, and pulses.

“GRDC will appoint three representatives from among growers or grower groups; one representative each from the west, north and south growing regions on each of these four committees,” Juan says.

“Advisory committees are the main innovation to the NVT program following the review and the solution addresses many of the issues raised during the industry consultation.”

Trial standards are also to be improved, with GRDC accepting the need to audit every NVT trial site at least once every year, starting in 2009.

Service providers to the NVT program can also expect to see GRDC reinforce staged payments and penalties built into the next funding period. In recognition of growth in the service provider sector, the GRDC expects to hold open, multi-stage tenders.

Additional changes are also in the pipeline, including making trial results available in hardcopy.


Crop competition off to the top of the class

Grain Growers Association (GGA) has launched a crops competition targeting agriculture students in Australian and New Zealand universities.

The Australian University Crops Competition (AUCC) initiated by GGA with founding sponsor Syngenta Crop Protection, has been developed to increase the knowledge and skill level of graduates and to help bolster young people into a career in the cropping industry.

Competition participants will be assessed in the areas of seed identification and analysis, pulse identification and analysis, grain grading, crop assessment including disease and weed identification, a business case and further processing (with relevance to the end user).

GGA Chairman John Eastburn says with the average age of Australian farmers increasing, the AUCC is one way GGA is encouraging young people to cement a rewarding career in agriculture.

Attractive career path

“GGA is committed to programs such as the AUCC which not only raise the profile of agriculture as a career choice but also provide participants with both knowledge and resources to better prepare graduates entering into a career in the grains industry,” John said.

The AUCC has three main objectives:

- Increase the pool of intelligent and enthusiastic young grain industry representatives;
- Increase the connectivity between universities, degrees and the rural industry; and,
- Enhance Australia’s international reputation and connectivity to the global grains market.

The competition will be held over 2½ days in Temora, NSW commencing Friday September 25 and concluding on the Sunday. The competition provides a relaxed competitive environment where GGA can assist students to develop their confidence and communications skills, as well as acquire and apply knowledge of the practical aspects cropping and business decision making.

The top five place getters will win a fully hosted four day international industry study tour.

The competition is open to all Australian and New Zealand universities and GGA is now seeking expressions of interests from both universities and individual students.

For more information on the AUCC visit www.unicropscomp.com.au

Competition Development:
Grain Growers Association Ph: 02 9986 2200 or 1800 620 519
Competition Management:
Event Directors Pty Ltd Ph: 02 4333 6039
Western region

Dry, dry, dry – Geraldton has had one of the driest starts to the year on record. Strong high pressure systems are keeping the sky blue and soil dry. This in itself is not a major problem but some growers have concerns about very little subsoil moisture.

There are a couple of areas in the south east of the region that had significant thunderstorm rain in mid April and are seeding. This area extends from west Watheroo to north east Carnamah. Some growers have planted crop that is now up and away.

Many growers are seeding dry and making steady progress on their programs. Canola and lupins are the main crops planted to this point but wheat will probably be underway next week. Heavy 2008 crop residues are posing a problem on many farms when the evening dampness arrives. Some growers are working late morning until late afternoon as dry stubble flows better through seeding equipment.

Many other growers have not started seeding and are waiting on rain to get underway.

The average break of season for our area is around May 20 so there is still a couple of weeks before the season could be classed late. The 28 day forecasts are for significant rain in the last week of May and the first week of June. If this comes off we are still in the running for a bumper season. Send her down Hughie!

Peter Norris, Agronomy For Profit
Geraldton
May 7, 2009

SOUTH COAST

Season conditions on the South Coast have been mixed during the past two months. There has been rainfall over the entire area but it has been patchy and light. For those lucky enough to get over 10–15 mm of rain, the topsoil and subsoil moisture has joined up very nicely.

Where this moisture has joined up, seeding has commenced. At this stage I would estimate that 25 per cent of the region’s canola has been sown, 50 per cent of the lupins are in the ground and some small areas of barley and wheat.

The earliest sown canola is now at the two to three leaf stage whilst the majority is at cotyledon to one leaf stage.

Apart from those growers lucky enough to be seeding, the remainder are continuing to knockdown paddocks, complete the last of burning windrows or chaff cart dumps and continue with last minute maintenance jobs on machinery.

Most growers are still very optimistic about this season. After 250–300 mm of summer rain the whole region has excellent stored soil moisture, with rain forecast for May 10–12, the remainder of the seeding should be completed by the end of May or the first week of June.

The only agronomic problem of concern is the threat of mice, there has been a big build up of mice over summer, it is not uncommon to see two to five mice holes per 100 metres, especially of the lighter textured soils. Baiting may have to commence if damage levels become obvious when crops are establishing.

Quenten Knight, Agronomist
Precision Agronomics Australia
May 3, 2009

Southern region

Temperature and rainfall

Conditions have ranged from cool to occasionally warm, but cooled noticeably in the last week of April.

The mean daily maximum and minimum temperatures were generally near average.

Strong winds on several occasions as weather fronts moved through.
Good rainfall throughout most districts late in April provided a very timely start to the season.

April rainfall generally varied from near average to well above average, with totals ranging from less than 10 mm on parts of the east coast of Eyre Peninsula – to more than 100 mm in the Mount Lofty ranges.

In 2008 we experienced a very patchy start, quite good winter rains but an exceptionally dry spring.

The 2009 season to date

Paddock preparation and seeding has commenced in most districts following good falls in late April. But follow-up falls will be needed in many areas to enable seeding to be completed.

For much of the month there were limited paddock activities, with some burning off, cultivation and snail baiting as well as some dry seeding of cereals and pasture for early stock feed.

The timely and widespread April rainfall provided a very good start to the season and paddock preparation for seeding got underway.

The rain has also provided an ideal opportunity for farmers to get an effective early weed kill prior to seeding – at the near optimum time – over the next few weeks.

Cereals for stockfeed are going in as well as canola and beans. There is also seeding underway for some wheat and barley crops for grain, but mainly where there has been good weed control.

Seeding is expected to progress rapidly during the first few weeks of May. But there are many areas – particularly those that received lighter falls – which are drying quickly and will need follow-up rainfall soon to enable seeding to be completed.

The total crop area in SA is not expected to change significantly on previous years. But the area of wheat, durum, canola and chickpeas may be up slightly with a consequent reduction in the area of feed barley.

Pastures

Paddock feed continued to decline during April with pasture paddocks in many areas having very limited surface cover.

Pasture germination and emergence should be good with the recent rain in the absence of earlier false breaks. But grazing will need to be carefully managed and farmers may need to provide some ongoing supplementary feed for stock until new pastures are established.

Perennial pastures as well as dry and early sown cereals are starting to provide a good source of feed.

Peter Fulwood
Rural Solutions SA
May 10, 2009

VICTORIAN MALLEE

Summer rains for November and December totalled 120 mm presenting a positive outlook for the upcoming cropping season. Following this rain there was no follow-up in January and February, and the confidence began to dwindle. But the months of March and April delivered about 25 mm each with the main falls occurring on Anzac Day.

This created a fantastic opportunity to get sowing on time or wait for a good germination of weeds. After a week there was a good green tinge across the Mallee, as the rains were general and this time, nobody missed out.

By the second week of May there was a lot of country sown, with a bit of sheep feed, oats and vetch sown dry earlier. With warm, moist soils, crops have begun to emerge well. Stored moisture was not high enough to give growers the confidence to sow canola, so this has been kept to a minimum. Input costs haven’t helped with oilseed production in the Mallee.

There has been the normal area of chickpeas and lentils, but this year there has been more vetch sown than all the other legumes put together. This is due to the options available in a vetch paddock. It can be grazed, green manured, cut for good quality hay, or harvested for seed.

Many growers will be finished sowing in the first week of June now that we have enough moisture to germinate dirty paddocks.

Now, with the season off to a good start, there will be a focus on the forecast to deliver a long awaited wet season.

Simon Severin
Landmark Berriwillock
May 6, 2009

MURRAY VALLEY RICE REPORT

The rice harvest was not completed at the time of writing this report (May 6), which was surprising. The crops west of Deniliquin certainly looked dry enough, but were still having problems with high grain moisture.

Harvest east of Deniliquin is completed, with yields mostly exceeding 10 tonnes per hectare, which is a good result for ground water. It is pleasing to see these growers obtaining good financial returns, particularly as they took the risk of growing crops in a year where channel water was not readily available to back-up flows from bores.

Yields west of Deniliquin are also above the average for the higher salinity bore water. Growers using groundwater in this location normally budgeted on yields of eight tonnes per hectare or less. Early indications are that have most of this crop is yielding at least nine tonnes per hectare.

Growers monitoring water salinity levels were often pleasantly surprised at the low readings they were getting in crops this year. These were expected prior to the New Year, given the cooler conditions and November–December rainfall. But there is no obvious reason for the situation in the first three months of this year as rainfall was virtually non-existent and crops encountered some very hot and high evaporation conditions.

Weather conditions for harvest were mostly sunny and dry. The majority of the eastern crops were finished before the late April rain. Western crops have had good harvest conditions in early May and should be all finished by mid month.

The main question being asked by Murray Valley growers is when will they have sufficient water to grow their next crop? No one expected they would have had a three year break and many now fear it will extend for at least another season. Water storage levels are currently very low, inflows have been minimal and the dry weather is continuing (Deniliquin has only recorded 33.2 mm rainfall so far this year).

There is still plenty of time for the situation to turn around.

John Fowler
District Agronomist, Deniliquin
May 6, 2009

GRiffith RICE REPORT

Irrigation allocations increased slightly in December and January following good rainfall in the catchments (resulting in 21 per cent for Murrumbidgee Valley general security irrigators, with an additional five per cent enhancement for Murrumbidgee Irrigation shareholders).

This was too late to affect the area planted to rice so farmers had to decide on the best use for this water; whether it be pre-irrigating winter crops or carrying
it over for the next season to irrigate rice or winter crops. Irrigation in the district ceased towards the end of April, with little water available for pre-irrigating winter crops and pastures. Across the district between 15 to 30 mm of rain fell towards the end of April. This was a welcome relief for most growers, although follow up rain will be the key to keep it going due to a lack of subsoil moisture. This rain was the highest falls most had recorded in a long time.

Up to May 5 only 58 mm of rain has been recorded in Griffith for the year, compared to the long term average for the same period of 139 mm. This rain was enough for growers on the lighter soil types to commence sowing winter crops, but on the heavier clay soils (without any pre-irrigation) it was marginal.

With the reduced rice area little winter crop has again been sod sown after rice. The rice harvest started mid/late March and yields have been variable, and in most cases disappointing due to the record heatwave conditions of late January/early February.

It appears crops sown early are likely to have been effected by high temperatures during flowering which caused sterility. Rice is susceptible to high temperature damage at flowering when temperatures reach 38°C. This was particularly the case with crops flowering around February 7 in the hot windy conditions.

Following on from this hot spell there was cold weather with a number of night time temperatures around 13 and 14°C. This may have caused some cold sterility in many of the very late sown crops which were going through microspore at this time.

Despite these disappointments many growers would still consider saving water and growing rice next season if they were guaranteed a good rice price.

Rachael Whitworth
Extension Agronomist
NSW DPI, Griffith
May 7, 2008

SOUTH-CENTRAL NSW

Rainfall has yet again been very isolated over the past two months, with falls ranging from nothing to 100 mm. Areas lucky enough to have been under the right rain cloud have capitalised on the moisture and canola, lupins and wheat are now out of the ground.

Areas with higher rain events are achieving up to 60–70 cm subsoil moisture and good moisture at seeding depths. Those areas that have missed out range from 0–30 cm subsoil, with the main issue being very marginal moisture in the top 10 cm. This is making planting decisions difficult.

Planting is about 50 per cent completed, with a reduction in canola area due to lack of subsoil moisture and rainfall. Canola is being substituted with chickpeas and wheat. There are some growers interested again in chick and field peas with an increase in planted area expected.

Weed burdens are not overly high at the present. There have been many reports of changing weed spectrums over the past one or two seasons. Most common ‘new’ weed problems are fleabane, bindweed and milk thistle becoming the most dominant.

The crops which have already emerged have again illustrated the importance in keeping adequate ground cover. Paddocks with greater than 60 per cent ground cover are planted and emerged but neighbouring paddocks with less than 20 per cent cover are still too dry to plant.

Press wheels again have shown their worth 10-fold with crops planted on very marginal moisture achieving 80 per cent plus establishment.

With everyone banking on a major rain event in late May, we will see the majority of the intended planting go in over the next two weeks.

Let’s hope the rains find us all!

Jim Cronin
Landmark Agronomy, Forbes
May 12, 2009

CENTRAL WEST

The sowing rigs have enjoyed an early start this year. Lovely rain was received at Easter time with falls of up to 100 mm, although this decreased markedly as you go further west and south. Starting moisture varies between 30 cm to 120 cm, depending on summer fallow management, ground cover and of course the amount of precipitation received.

It is the early break we have had this century, and farmers are ‘Big Kev-ed’ (excited) about this. So much so, that the biggest challenge has been to slow farmers down from sowing too early – ‘cool you jets’ being a common call by many agronomists around the place! Our farmers have a strong belief in global warming and the frost incidence is going to be less this year!

Crop mix has changed a little to reflect the early break. The area sown to lupins and canola has certainly risen. Early wheat varieties have been popular, with a move to main season cultivars taking place at the moment.

Chickpeas are also being planted at the start of May, and hopefully they will have enough moisture under them to produce some pods and not just vegetation – at least they should have some height at harvest time this year, as opposed to our June sowings of late.

The longer growing season could put the crop under even more pressure from the dreaded Ascochyta, as disease levels will be very high after 2008.

Barley areas will be down due to its low commodity price and the earlier break – some early sown malt might go in against this trend.

Cotton harvest is just about completed with the area planted somewhere around the 4600 hectares – far short of the 50,000 that can be sown on full water. Yields are quite good but the extreme temperatures in January didn’t help this cause.

Penny Heuston
Heuston Agronomy Services
May 8, 2008

Northern region

Overview

The later summer crops are being harvested and cotton picking is in full swing, with many respectable yields being recorded despite such a dry second half to the summer. The winter outlook is still waiting on rain – so far only isolated falls have been received.

Summer

Sorghum has performed well with most of the crop planted and harvested early. The early sowing has once again been the best option, mainly because of the rainfall distribution, but late crops have been fair, with fewer standability issues this summer. But the Chinchilla area only had average yields with less rain through the area.

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Early maize was good but a large mid summer planting of dryland maize is approaching harvest and most probably storage, as markets have tightened up. Silage maize has yielded well for the conditions, and gritting corn has been more successful planted early, with some disease issues on later crops.

Pulse yields have generally been below expectations, mainly due to the lack of rainfall and shortages of irrigation water for a dry season. Mungbean yields were below par, with soybeans very dependent on late irrigations. But some of the new varieties with enough water have yielded in excess of 5.0 tonnes per hectare.

Cotton yields have been good with good quality, and dry conditions are aiding harvest. Dryland yields have been good and irrigated production also very good in areas.

Winter

The choice of winter crop varies across the Downs. On the Eastern Downs most growers are planting APH wheat as their main crop with some interest in chickpeas, but most of the sorghum country is too dry to double crop into chickpeas. Some oats have been planted and are growing on the isolated showers that have been around.

West of Dalby there is strong interest in chickpeas provided fresh paddocks can be found with enough of a buffer from last year’s crop. Ascochyta in chickpeas and stripe rust in wheat are major concerns for all growers, and there is a lot more interest in a fungicide management program for the winter.

Despite low feed prices at present, there is a fair interest in barley as a rotation on wheat country. Overall the winter crop area is expected to be similar to last winter.

Hugh Reardon-Smith
Agronomist Landmark, Pittsworth
May 8, 2009

CENTRAL QUEENSLAND

In Central Queensland, a very wet January–February 2009 was followed with no rain in March and patchy rain in April. Falls of 30–50 mm were common but were variable with some farmers receiving less than 20 mm and others more then 60 mm. One farmer at Clermont said the 60 mm of rain they received has probably added between 0.6–1.2 tonnes per hectare to his sorghum crop and will ensure there are no screenings and minimal lodging.

Springsure to Rolleston is very dry and Emerald to Clermont is dry in patches. The Dawson Valley is also quite dry.

More than half of the sorghum crop north of Emerald is yet to come off. While many sorghum crops in CQ suffered severe denitrification in 2008, which resulted in lower yields, sorghum crops this summer are good to excellent. Yields of 2.5–3.5 tonnes per hectare across the farm have been achieved with a few paddocks doing 5.0 tonnes which is excellent for CQ.

In most cases the quality is good with only a few reporting some pinched grain in the ‘patches’ that missed the April rain.

Feathertop Rhodes grass (Chloris virgata) continues to be a major problem then one tonne per hectare in ‘good crops’ and complete failures in the patches where FTR dominates.

A large area – probably 70,000 to 100,000 hectares – of wheat has been planted. Establishment varies from excellent to ‘send me rain quick so as to make me a good farmer’. There is potential for another 100,000–150,000 hectares of wheat to be planted if good rain – 50 to 100 mm is received in the next month.

A significant area of chickpeas – 35,000 to 40,000 hectares has been planted. But most is still to emerge and much of it has been deep planted to get to moisture.

Maurie Conway
QPI&F Emerald
May 8, 2009

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ANSWER TO IAN’S MYSTERY TRACTOR QUIZ

The tractor is a 1920 Canadian 14-28, manufactured by The Alberta Foundry & Machine Company of Medicine Hat, Alberta. The horizontal two cylinder engine developed 28 HP. Both the single rail chassis and the rear wheel spokes were manufactured from Canadian hardwood. The photos were taken in Canada and are of the only two remaining examples. The green tractor photo shows the author at the controls.