Technology wizards in Oz vital to success

While the UK debates how to spend levy money, the Australian approach to research is bringing big benefits to one farm, as Bayer's **Mike Abram** found out on a recent trip Down Under

Levy-funded research is playing a key role in keeping one family farm in South Australia both profitable and sustainable, overcoming challenges such as resistant weeds.

Belinda Cay says the biggest priority on her 1,150ha family farm, near Owen, is cost of production. This is where research carried out by the Grains Research Development Council (GRDC) is helping her improve efficiency.

"Our farm does not receive any subsidies so we are really conscious of our labour and machinery costs. We've taken the approach that to be the best farm possible we have to adopt new technology to make sure we are really efficient."

The farm's biggest challenge is to use the available water as efficiently as possible. "We don't irrigate our cereals crops, which makes rainfall our limiting factor.

"Along with other farms in South Australia, our benchmark for success is how many kilogrammes of grain we produce per hectare per millimetre of rainfall."

SHARING WEATHER DATA

Wheat is planted around Anzac Day in late April through to mid-May, allowing the crop to take advantage of winter rainfall before harvesting in November. The varieties do not require vernalisation for flowering, as winter is mild so sowing dates and variety choice are carefully scrutinised and aligned with changes in day length.

Weather stations are strategically placed around the farm, and for the past five years these have been used to make detailed weather mapping plans to help guide sowing date decisions.

The farm is also part of a network of local growers, who share best practice, farming strategies and ideas.

"As an example of how we work together, we now have real-time, web-based plant available water monitoring systems, which are integral to the way we work.

"There are about 11 farms which have soil moisture probes; this gives us a great insight into our soil moisture levels, and allows us to estimate at any time in our season what our yields are going to be."

Ms Cay explains that the reason for doing this is that crop yields are limited by water. "We need to match our nitrogen application to drive the yield potential we believe is available for that season.

"In a good year we will put more nitrogen on, in a bad year, less – every millimetre of rainfall will affect how we manage our crop. If we put too much N on, we will bulk up our crop and put on too much biomass that won't be sustained to produce the yield at the end."

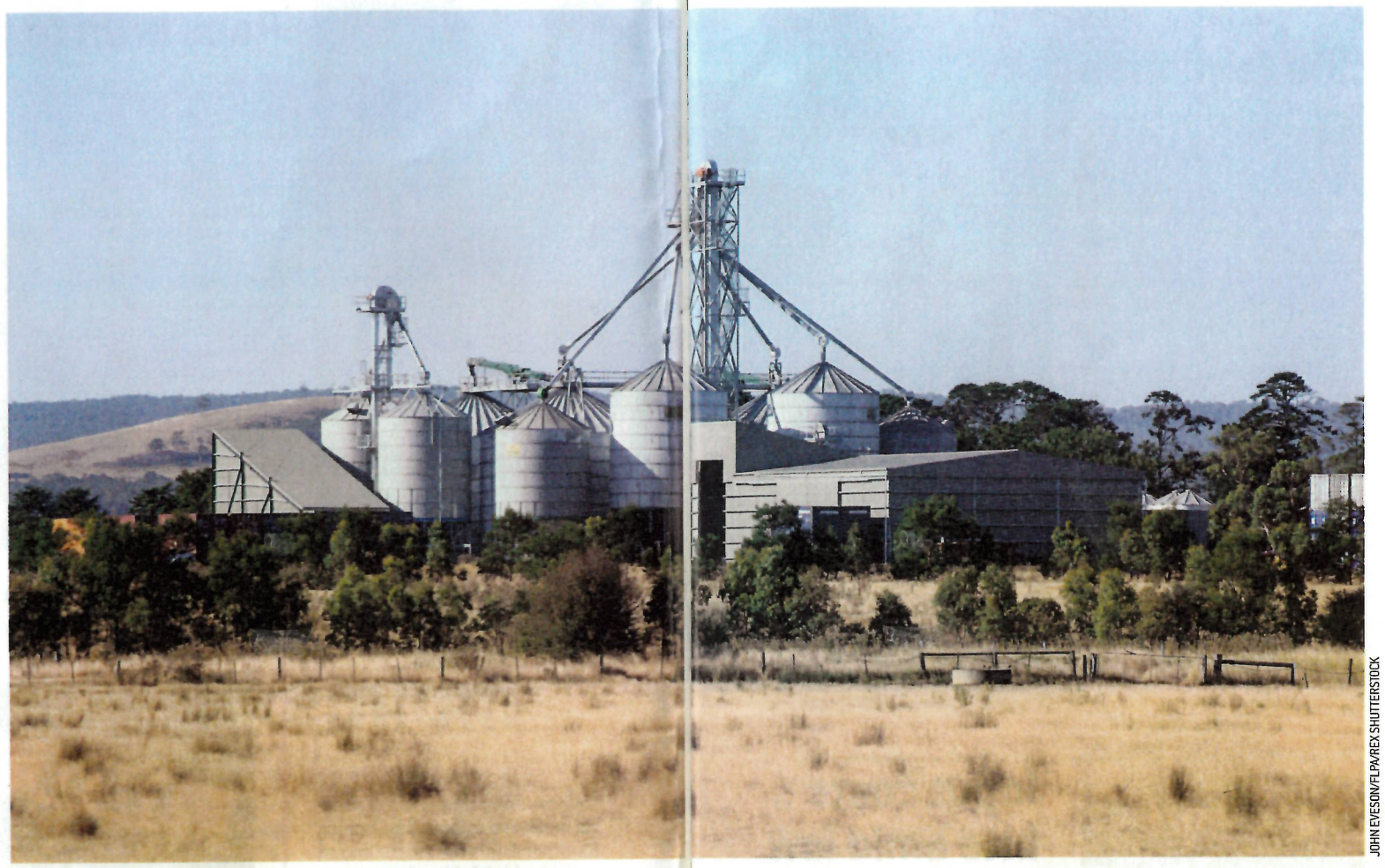
BREEDING

Innovations in plant breeding are also helping push production, Ms Cay says.

The farm's soils contain high levels of boron and transient salinity, so producing varieties that can cope with these stresses has been critical.

"The council, over the past 15 years, has funded the development of new varieties that have greatly increased yields. One of the advancements has been a resistance gene for boron toxicity, which has been important for us."

A previous breeding breakthrough introduced cereal cyst nematode resistance into varieties, which changed the face of our farming, she adds.



JOHN EVESDN/FLPA/REX SHUTTERSTOCK

Australian farmers pay a levy of 46p/t to fund research projects.

Belinda Cay is using technology to cut the cost of growing cereals.

AUSTRALIAN GRAIN

Farming facts

* Australian farmers produce 93% of country's daily food supply
* Each farmer produces enough food to feed 600 people (150 domestically, 450 overseas)
* Three main grain growing regions in Australia
* Most Australian grain produced only using natural rainfall
* Half of Australian grain farms are mixed farms with livestock, 50% specialised arable farms
* In 2015, Australian farms forecast to produce 38.7m tonnes of grain

Cropping facts

22.9m ha of winter crops planted:

* Barley – 4m ha (8.2m tonnes)
* Canola (OSR) – 2.3m ha (3m tonnes)
* Wheat – 13.8m ha (23.6m tonnes)
* 1m ha of summer crops planted (3.8m tonnes) – mainly grain sorghum, rice and cotton
* 65% of Australian wheat exported (worth AUD23m to economy). About 10% of global export market

Key challenges for Australian grains industry

* Climate variability and water use
* Heat and frost
* No-till farming led to weeds, pest and disease challenges
* Low fertility soils
* Shifts in market demands (gluten intolerance, Asian demand for red meat)
* Grower profitability (input and labour costs high)

CSIRO RESEARCH

* Researchers are developing automatic sensors that allow breeders to obtain key information about new varieties much more rapidly.

This will speed up the process of bringing new varieties to market.

The researchers, funded by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), Australia's national science agency, have developed a golf buggy "Phenomobile."

The high-clearance buggy has laser scanning capabilities that can produce a 3D representation of the crops.

It is aimed at measuring characteristics that don't change very quickly, such as crop height, leaf angle, spike numbers and even biomass, explains CSIRO researcher Jose Jimenez-Berni, based near Canberra.

"Everything we know that can give us some useful information we have added to the machine's capabilities and it is all collected by a computer at the back."

But it is expensive and not very portable, so CSIRO developed a lite-version, with simple software for operation and which is much easier to take through crops, explains Mr Jimenez-Berni.

The system simplifies the capture of data – for example, automatically recording crop height or leaf angle rather than being done manually with a tape measure or protractor, he says.

"We can even measure spike numbers, which previously would have to be done in a laboratory," he adds.

More complicated measurements can be made, too. For example, comparing which varieties are photosynthesising for longer during the maturity phase, which could be an indicator of longer grain feeling that could provide better grain quality attributes.

Other equipment has been developed to take readings of variables that could change more rapidly, such as crop temperature.

"Cooler temperatures, for example, are an indicator for high transpiration rates, so could be used to help select for varieties with better water use efficiency," Mr Jimenez-Berni notes.

RESEARCH AND INNOVATION KEY TO FEEDING A GROWING GLOBAL POPULATION

* One hundred young people from around the world highlighted research and innovation to intensify or develop new production systems as a key driver for feeding a growing population.

The delegates at Bayer CropScience's Youth Ag-Summit in Canberra also highlighted the need for education about agriculture to the wider public, building skill levels of farmers and advisers, and tackling food waste and consumption.

These themes were built into the Canberra Youth Ag-Declaration, a global call for action to help solve the pressing issues facing agriculture and food security.

This declaration was presented in October to the UN's Committee on World Food Security in Rome.

The other area Ms Cay is conscious of is crop rotation.

"Continuous wheat is not possible because of soil-borne diseases," she says. "So we use a wheat, barley, lentils or chickpeas rotation on some fields, while on others it is a wheat, barley, oilseed rape rotation."

Oaten hay, which they export to Japan, has also been introduced to the rotation partly because it is an incredible weed and disease break.

"Again, through the work of the GRDC we have learned a lot about the science behind our rotations and how we can manage them to be more effective weed and disease managers."

WEEDS

Resistant weeds are a huge challenge in Australia, so another part of the farm's integrated weed management plan is to either burn the windrow dropped by the harvester or use a chaff-cart to capture all the chaff at harvest. This chaff is then either fed to livestock or burned in piles.

This can remove 80-90% of the weed seeds otherwise returned to the field in the header chaff and straw streams. Crops are direct-drilled, inter-row sowed into the previous crop's stubbles.

"It's really important to retain our stubble to help protect against the strong summer winds and during the crop establishment phase each year. If we didn't we would lose our topsoil, which is only 15cm deep."

SOIL MOISTURE

No-tillage systems also retain more water, so it allows less evaporation over the harsh summer months, where temperatures can reach more than 45C.

"Last summer we had five consecutive days of temperatures of over 46C, so it is a pretty harsh environment. Moisture is also crucial, and these stubble retention systems have helped push our average yields over 3t/ha using only rainfall-fed crops."

Improvements in the direct-drill system are also being researched by Ms Cay's brother, James Barr, as part of his GRDC-funded PhD to reduce the risk of soil erosion.

"James is working on a new bent-leg seeding tine, which instead of ripping a line in the soil, actually lifts the soil up and puts it down on to the seed, and minimises soil throw."

Every square metre of the farm is mapped using satellite systems to determine the topography, soil type and salinity and then yield maps are overlaid. That has helped match inputs to potential outputs.

"For example, we have found some areas that are susceptible to frosts in August when grains are flowering, and we can lose up to 15% of the yield. So we monitor those areas separately and, if necessary, will cut affected areas for hay.

"It is thanks to these types of technologies that our family farming business is successful," Ms Cay concludes.

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GRAINS RESEARCH DEVELOPMENT COUNCIL

* Levy of 99c/t (46p/t) of grain matched by government funding for Grains Research Development Council research
* Budget of $195m/year (£90m)
* Funds about 1,100 projects

Projects include

* National Frost Initiative to help protect crops against late frosts
* Omega-3 oilseed rape breeding
* Ultra-low gluten barley
* Breeding for more water efficient crops
* Increasing nutrient efficiency in crops through better application
* Smartphone apps for decision support