NEW HORIZONS
EXPLORED AT AGRONOMY CONFERENCE

High rainfall cropping research dominated proceedings at the Australian Agronomy Conference, held offshore at Lincoln, New Zealand from November 15-18, 2010.

The conference theme, Food Security from Sustainable Agriculture, is at the core of the Grains Research and Development Corporation’s (GRDC) initiative to assist expansion of crop production within Australia.

As rainfall becomes more variable over the next 30-50 years, finding areas that are capable of producing food crops is crucial.

GRDC hosted a high rainfall zone (HRZ) grain production workshop at the conference which featured presentations from researchers including Penny Riffkin, Department of Primary Industries (DPI) Victoria; CSIRO researchers Heping Zhang (see page 2), John Kirkegaard and Andrew Young; and Peter Sale, Latrobe University, Victoria.

The speakers outlined progress on GRDC-funded HRZ projects that have yielded great results in recent years and are being featured in this newsletter.

Workshop participants identified several opportunities for HRZ research, including linking into and accessing information from other GRDC research initiatives, including water use efficiency, crop sequencing and Grain and Graze.

GRDC welcomed the attendance and input from New Zealand research organisations as there are many commonalities such as managing risks during the season, early and late sowing, crop establishment, and pasture to grass stubble management.

The HRZ workshop identified issues needing more research work, including tackling environmental challenges such as soil and climate; the affect of managing variables in farming systems, for example sowing date and density and nitrogen regulators; and breeding priorities, as well as phenology, height and allocation.

Ever-present constraints such as plant available water, weeds and diseases were also discussed, including the threat of yellow dwarf virus in barley, root lesion nematodes and wheat streak mosaic virus.

Applying fertiliser economically was a concern for researchers who would also like to see HRZ sessions included in future GRDC Updates where appropriate.

GRDC is committed to research in the HRZ that will contribute to the sustainability of the Australian grains industry and, ultimately, food security. For more information on the Australian Agronomy Conference, visit www.agronomy.com.au

Tanya Robinson
GRDC PROJECT MANAGER
PRACTICES AND HRZ
MEET THE RESEARCHERS
DR HEPING ZHANG, CSIRO

Dr Heping Zhang is a CSIRO Research Scientist with interests and expertise in agronomy, crop water use efficiency, and the physiological determinants of crop yield.

Dr Zhang is currently assessing the yield potential of wheat and canola in the high rainfall zone of southwestern Australia.

Dr Zhang has a background in improving water use efficiency in dryland agriculture through agronomic management and supplemental irrigation at the International Center for Agricultural Research in Dry Areas (ICARDA).

He is now applying that knowledge in Australia’s HRZ in assessing yield traits and identifying constraining factors which are preventing wheat and canola varieties reaching their potential in the HRZ.

Dr Zhang’s research aims to then develop agronomic management strategies to reduce the gap between the actual and potential yield of wheat and canola.

For a list of the many scientific papers published by Dr Zhang on the topic, visit the CSIRO website at www.csiro.au/people/Heping.Zhang.html.

(Source: CSIRO)

TOP TIPS FOR RHIZOCTONIA

It is estimated that Rhizoctonia, a major disease of the high rainfall zone in southern Australia, costs $77 million each year in lost production.

Rhizoctonia barepatch of cereals is caused by the soil fungus Rhizoctonia solani, which causes crop damage by pruning the root system, which results in water and nutrient stress to the plant.

And while Rhizoctonia cannot be eliminated, suppressive soils can provide complete control of Rhizoctonia in some situations and at present provides the best long-term control option.

Inoculum of Rhizoctonia survives on organic matter in the top 0-10cm of soil and grows as a ‘web’ of fungal hyphae or filaments through soil. Good farming practices can promote disease-suppressive activity in the soil’s microbial communities which limit the expression of Rhizoctonia.

- Cultivation – break-up of fungal hyphal networks. Cultivation one to two weeks prior to sowing can be very effective.
- In seasons with an early break, remove volunteer plant growth as soon as possible, using either cultivation or herbicides.
- Rhizoctonia can only attack very young plant roots so anything that increases early root growth can significantly reduce disease.
- Adequate soil nutrition – particularly P, N and zinc (Zn).
- Soil disturbance 50mm below seeding depth in no-till systems – narrow points. Deeper ripping can be advantageous in compacted soils.
- Early sowing into warm soils where possible.
- Avoidance of SU herbicides – both pre and post-sowing applications and residues from the previous season.
- Some seed coatings may increase rate of early root growth and provide some reduction in root damage through suppression of Rhizoctonia barepatch

A rhizoctonia fact sheet is available on the GRDC website at www.grdc.com.au/hrz

CHECK OUT GRDC’S HRZ WEBPAGE FOR THE LATEST:

- Project summaries
- Media releases and feature stories
- Electronic copies of HoRiZon newsletter
- Key contacts
- Useful links


Canola and pulse crops are usually less susceptible than cereals.
In cereals, oats are most tolerant followed by triticale, wheat and then barley, which is the most intolerant.
Applications of N to deficient crops can reduce yield loss in poor growth patches by up to 50%.
PROJECT NEWS

In each issue the HORIZON newsletter will outline the conclusions from key GRDC-supported HRZ projects. For more project summaries, visit www.grdc.com.au/hrz

PROJECT NUMBER: CSP00019
PROJECT TITLE: Wheat breeding for the high rainfall zones of Australia
PROJECT SUMMARY: The HRZ of Australia continues to expand and more diverse wheat varieties are urgently required. The main focus of this project is on developing feed wheats which can be sown from February to June. Significant achievements were:

1. Identification of two dual-purpose feed wheats for commercial release. CS95102.1 has been the highest yielding line in Victoria, SA, Tasmania and NSW whereas HRZ03.1010.3 appears specifically adapted to east Gippsland.

2. Establishment of an outdoor quarantine nursery in the ACT which enables direct introduction of lines from NZ Plant and Food Research.

3. Enhanced understanding of the relationship between sowing time and flowering time to enable more efficient breeding progress.

Mixed farming enterprises involving cropping and livestock predominate in the HRZ. Mixed farming in the HRZ lends itself to growing longer season dual-purpose wheats which can be sown for grazing and grain or for grain only.

The demand for feed grain in the HRZs is high and feed grain varieties are being bred in this project. Disease pressure is also higher in the HRZ and greater emphasis is put on breeding for disease resistance.

The varieties most suited to the HRZ are very different to those found in the main dryland wheat growing areas. The aims of the project were to firstly, establish an outdoor quarantine facility to introduce wheats that are well adapted to HRZ farming systems including disease resistance and produced adequate seed for immediate field trialling.

3. Dual-purpose feed wheats that have a requirement for low temperatures (vernalisation) and daily exposure to light (photoperiod) to hasten plant development and flowering are unlikely to be suitable for the HRZ of WA. However, winter wheats without a photoperiod requirement may be suitable. This needs further testing, particularly given the increased interest in grazing and grain in WA.

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Australia’s high rainfall zone continues to expand and more diverse wheat varieties are urgently needed.
‘SKYPE SHED MEETING’
LINKS GROWERS ACROSS STRAIT

Leading grain grower Richard Heath, “Pine Cliff”, Gunnedah, NSW, crossed two states and the Bass Strait in March to address Tasmanian growers – all without leaving his farm office.

Mr Heath joined the Southern Farming Systems (SFS) precision agriculture (PA) field day at “Glenroy”, Cressy, via the internet video program Skype to share his experiences in PA and on-farm trialling.

The “Skype Shed Meeting” is part of a GRDC program linking high rainfall zone (HRZ) growers with the latest research, development and extension information.

Mr Heath says PA technology has allowed him to take GRDC research results and ground truth them in the commercial setting of his family’s Gunnedah mixed grazing farm, leading to a reduction in fertiliser use by 10 to 15 per cent.

Mr Heath farms 5500 hectares at “Pine Cliff” in the tightly-held Liverpool Plains region, with his father Malcolm and brothers William, Rory and Stephen.

He says on-farm trialling is within the reach of any grower, particularly now that PA technology can collect and map data such as fertiliser application, soil type and yield.

“I like doing on-farm testing and trialling and it’s just so easy to do these days with PA technology,” Mr Heath says.

“I see PA as a way of doing that at a farm level and really backing up management decisions with some numbers.”
"I still rely heavily on the researchers and GRDC-funded small-plot trials to give me ideas of what I should be looking at. I then take that to the farm level and incorporate them in what I'm doing."

Andrew Whitlock, of consultancy PrecisionAgriculture.com.au, was a key note presenter at the field day and told growers it was important to set easy goals first and that PA was not all about variable rate fertiliser in the HRZ.

"Adopting PA technology gives you the tools to gather information to understand your farm and to measure performance so you can manage inputs for the best results," Mr Whitlock said.

He said the 'big ticket items' in the HRZ included: autosteer for inter-row sowing; measuring water logging; soil pH, soil constraints such as sodicity; nitrogen management and strategic application of manures.

He advised growers to start with a digital farm map and progress to contour/elevation maps, satellite imagery and yield mapping.

He also encouraged growers and agronomists to implement more on-farm trials which are easily evaluated using precision agriculture technologies.

For more information, visit www.precisionagriculture.com.au.

Precision Agriculture (PA) within the high rainfall cropping zones of eastern Australia has recently been focusing on the improvement of surface water management through the use of 10 centimetre contour maps, 3D elevation modelling and water logging risk maps.

Farmers who have been monitoring crop performance with satellite imagery and yield maps have the ability to investigate/ground truth paddock variability and determine return on investment (ROI) calculations from simple on-farm trials.

Interest is emerging in using satellite imagery and/or tractor mounted crop sensors to assist with decision making about variable nitrogen application rates.

However, PA is not just constrained to growers with the ability to implement variable rate. Many growers and agronomists are integrating their maps with existing paddock knowledge in order to further understand risk and support management decisions.

It is the ability to integrate spatial information with farmers' and agronomists' knowledge which determines the true value of PA.

– Andrew Whitlock, Precision Agriculture
Successful trials of dual-purpose canola have paved the way for the development of new longer-season varieties for both grazing and grain production in Australia’s high-rainfall zones (HRZ).

This four-year research project led by CSIRO’s Dr John Kirkegaard, was supported by the Grains Research and Development Corporation (GRDC), and also involved the South Australian Research and Development Institute and Marcroft Grains Pathology, Victoria.

The project realised the potential for farmers to improve profitability on mixed farms using currently available canola varieties for both grazing and grain production.

Canola can produce a significant amount of high-quality forage and regrow after grazing to yield as much as traditional, un-grazed canola crops when “best-bet” management strategies developed during the research are followed.

Dual-purpose canola also retains the break-crop benefits for weeds and disease to clean up paddocks for subsequent cereals or for pasture establishment.

Following on-farm field experiments in NSW, the ACT and South Australia, Dr Kirkegaard’s team last year released the “best-bet” management guides to help southern Australian farmers maximise the profitability from the sheep and canola production.

“Growers in medium-rainfall areas of southern NSW have successfully adopted a system utilising commercially available spring varieties sown two to three weeks earlier than normal (from mid-April) and grazed in early winter prior to bud elongation, with minimal impact on final yield or oil content,” Dr Kirkegaard said.

This year’s trials have focussed on the potential advantages of later-maturing winter, winter-spring varieties over late-spring canola varieties for grain and dual-purpose use in the HRZ.

“In longer-season, high-rainfall areas, the winter and winter-spring varieties, not commercially available in Australia, out-yielded currently available late-spring varieties for the earliest sowing times (March/early April) and provided more forage for grazing sheep,” Dr Kirkegaard said.

“The feasibility of utilising later-maturing winter varieties in cooler, long-season HRZ areas was also demonstrated in field experiments near Canberra ACT, where the later maturity provided opportunities for earlier sowing, a longer grazing period, and higher yield potential of both grazed and ungrazed crops.

“Given the varieties tested in these experiments are unadapted, imported European lines, there seems good scope to develop and make available a long-season dual-purpose canola option for mixed farms in Australia’s HRZ.”

Dr Kirkegaard’s work with canola is now integrated with similar research into dual-purpose wheat with Dr Hugh Dove, to investigate the systems benefits of an integrated farming system, in which sheep can move from pasture to canola and onto wheat, before returning to pasture, thus widening the grazing window.

CROP RESIDUES: ASSET OR LIABILITY?

As better crop production practices boost yields in Australia’s HRZ, stubble management has emerged as a double-edged sword for the region’s growers.

Martin Blumenthal, GRDC agronomy, soils and environment program manager says attitudes are changing as growers switch from looking at crop residue as a liability to be managed, to an asset worth exploiting.

GRDC-funded research is making significant gains in effectively handling crop residue.

“Yield has improved in a relatively short time period since cropping in Australia’s HRZ expanded in the early 1990s,” Dr Blumenthal said.

“Along with this yield response has come an increased level of crop residue left in paddocks.

“This was typically considered a waste and came with additional costs, despite the relative ease of burning.”

Dr Blumenthal says crop residues are now being considered an asset in the whole farming management system, with dramatic changes in the landscape and a better understanding of opportunities and processes in a drying farming environment.

“Stubble retention is now a serious consideration in any machinery purchase, nitrogen input system or harvest process,” he said.

“Farmers who have implemented alternatives to burning have done so not to take on another challenge, but with the realisation that sustainable farming systems work more naturally, than destructively, allowing for less stress on all aspects of the farming system.”

Dr Blumenthal says the myth that stubble retention increases the level of pests has now been quashed, allowing farmers to use integrated pest management (IPM) to undertake more strategic monitoring and less application of non-required pesticides.

“The key outcomes of the GRDC-funded Southern Farming Systems (SFS) research is proof that stubble retention can be achieved in the HRZ without a yield penalty and with improved water use efficiency,” he said.

“This has led to a greater uptake of sustainable farming system practices which, only several years ago seemed unlikely.”

Dr Blumenthal estimates more than 80 per cent of growers are considering stubble retention and that many are already practicing various methods to gain the social, economic and environmental benefits on offer.

The GRDC-funded research promotes a move away from stubble burning. It has focused on stubble retention, inter-row seeding and row spacing trials, incorporating variable seeding and nutrient management inputs.

“Precision Agriculture, including Variable Rate Application through disc seeding, in a reduced carbon emission climate would answer the next phase of forward thinking applicable in a rising input cost market,” Dr Blumenthal said.
Revenue® was bred via a publicly funded GRDC/CSIRO project.

For Tasmanian grain grower Nick Taylor, the promise of a 10 per cent boost in yield was more than enough incentive to adopt the new Grains Research and Development Corporation (GRDC) and CSIRO-bred wheat variety Revenue®.

“Revenue® is going to be the benchmark across the high rainfall areas of Australia,” Mr Taylor said.

“It’s consistently performed better than other varieties in the Southern Farming Systems (SFS) trials over the last five or six years.

“We’re hoping that it’s going to give us a 10pc yield improvement so that’s exciting and it’s looking pretty good this year.”

Mr Taylor, who operates a mixed farming and grazing business with his parents Jim and Anne, says identifying research problems and working towards solutions is the key to maximising production on their 1250-hectare Nile property, “Lochmaben”.

He currently holds the position of SFS Tasmanian director and is keen to see other growers adopting research gains that ultimately come from their investment via GRDC levies.

“There are people still growing old wheat varieties that they don’t know the name of and that’s fairly unscientific compared to the data that SFS is producing and it’s pretty hard to argue with science.”

Revenue® was bred via a publicly funded GRDC/CSIRO project and is a red-grained feed quality winter wheat variety which is short in stature. It was bred by AusGrainz and CSIRO and is being marketed by GrainSearch Pty Ltd.

Research scientists report it has good early vigour with
similar maturity to Mackellar and produced high yields in initial testing. It is expected to capitalise on a good season as well as performing in tougher conditions.

Mr Taylor said waterlogging was the biggest yield limiter but GRDC-funded research into raised beds and new varieties was helping HRZ growers combat the problem.

“A dry winter produces our best yields and a wet winter severely limits our yields, perhaps down to a third of a yield we might expect in a dry winter,” he said.

Mr Taylor is using raised beds to enhance drainage and cope with a 607-millimetre annual rainfall. He is also growing red winter wheat varieties which he says are a big leap forward for HRZ cropping.

GRAINSEARCH TRIALS SHOW:

- Early sowing (April 22) resulted in significantly higher grain yields compared to late sowing (May 22).

- In order to achieve maximum grain yields, Revenue should be sown in April and the earlier the better. Revenue has a vernalisation (hastening plant development and flowering by subjecting seeds or seedlings to low temperatures) requirement which means the variety will not flower early if sowing is undertaken early, so the frost risk is not increased through early sowing.

- Grazing of the early sown treatments did not have a negative impact on grain yields, so long as the grazing was completed before the end of July. To maximise gross margin per hectare, grazing could be undertaken, provided pugging and waterlogging is not an issue.

- Late sowing did not allow for grazing to be undertaken. If grazing is a priority, do not sow Revenue later than the third week in April.

- Grain protein was not affected by grazing of the early-sown crops. However, there could have been some protein dilution due to the higher yield of the early-sown treatments.

- Grain protein was higher in the late-sown ungrazed plots compared to the early sown ungrazed crops. This was undoubtedly caused by a reduction in grain yield with the later sowing.

- Early sowing produced grain of good test weight. Grazing did not impact adversely on grain test weight, so long as sowing was early.

- Grain test weight was significantly lower in the late-sown ungrazed treatment, compared to the early sown treatments (grazed or ungrazed). In order to achieve grain of good test weight, sowing of Revenue should be undertaken in April.

- Grazing delayed flowering by approximately five days, and reduced plant height by approximately 20 centimetres. The delayed maturity did not impact yields.

SELECTING VARIETIES FOR THE HRZ

The National Varieties Trials (NVT) website provides an easy search tool to find how different grain varieties are performing in the high rainfall zone. The NVT Online site provides quick and accurate information on variety performance to help growers select the best-performing lines for their farm’s location.

Upon entry to the NVT Online home page, growers should select the ‘View Latest Results’ button located on the map of Australia in the centre of the page.

The mapping function will then ask users to select the type of crop they are interested in (wheat, canola, barley etc), as well as their postcode, before clicking the ‘Filter’ button to search for results.

The site will display icons at all the trial sites for that crop in that region. By clicking on one of the icons, users will then be able to access long-term yield data for each of the varieties grown at that area.

www.nvtonline.com.au
New research shows subsoil manuring may boost crop yields by up to 60 per cent on problem subsoils in the HRZ of southern Australia.

La Trobe University researcher Peter Sale says that although the technology is expensive to implement, the increases in grain yield and quality achieved on these soils are likely to offset the cost of subsoil manuring in just a few years.

With many traditional grain producing regions suffering drought conditions over the past decade or more, southern Australia’s HRZ is becoming an increasingly important grain-producing region.

Its long growing season and mild spring temperatures make the region more reliable for cereal and canola production, but the dense clay subsoils present across the region limit crop performance, often to only one-third of potential yield.

The soils are known as ‘duplex soils’, with lighter textured sandy-loam or loam topsoils overlying fine clay particles packed together into dense subsoil layers.

The problem with these soils is that they can become waterlogged on top of the clay in the winter, and then become too dry above the clay in late spring, particularly if there is a dry finish.

The plant roots are generally restricted to the upper soil layers, and the so-called “bucket size” of the soil (the soil volume providing water and nutrients to plant roots) is limited.

Researchers have been trying to modify the clay subsoils for many years to improve forage and crop production, but with limited success. The GRDC-funded research now shows that subsoil manuring is a promising practice for improving these subsoils.

“Subsoil manuring involves incorporating organic matter into the clay layers at a depth of 30-40 centimetres,” Dr Sale said.

“We achieved amazing results in field experiments at Ballan from 2005 to 2007, where we incorporated high rates (20t/ha, fresh weight basis) of organic amendments into the sub-surface clay layers prior to growing a long-season winter wheat.

“The results in 2005 showed an impressive dryland yield of 11–13t/ha of high-protein wheat on the amended plots, and only 7-8t/ha on the adjacent control and deep ripped plots – an increase of around 60 per cent.”

Water utilisation was increased, with the treated plots extracting around 60 millimetres of extra water from below 40cm soil than the untreated control, and nitrogen uptake was almost doubled in the organic amendment plots, compared to the untreated controls.
“We achieved amazing results in field experiments at Ballan from 2005 to 2007...”

Dr Sale said subsoil manuring changes the physical properties of the upper layers of the clay subsoil, enabling the roots to extract the soil water from this layer.

“The organic amendment also releases plant nutrients and these appear to stimulate deep root growth and crop response” he said.

Dr Sale said the most significant finding was the increase in water usage by the crop. “In our trials in 2005, when the manured crop used the extra soil water from below 40 cm, we became concerned that the crop had used all of the deep subsoil water, leaving nothing for the 2006 crop – but this was not the case.

“The whole soil profile filled up again from the summer and autumn rain in 2006, and the wheat crop on the subsoil manured plots was able to use an additional 90 mm of water during the 2006 drought, and yielded an extra 2t/ha above the control.”

With funding from GRDC, Dr Sale was able to extend the experiments to a number of sites across south west Victoria in 2009 – the year when a potentially bumper crop was affected by a heat wave in early November.

“We saw the subsoil in our control plots starting to dry out in late October compared to the subsoil manured plots,” he said.

“The manured crops were less affected by the high temperatures, and the final crop yields showed large increases in grain yield. Thus the results we obtained at Ballan were repeated at three other sites in south west Victoria.’

Dr Sale said that the technology was expensive – yet the research was suggesting that as long as there was active, continuing root growth in the amended clay layers with successive crops, then the effect of subsoil manuring could be long-lasting. “We were astounded when we returned to a paddock at Ballan four years after 20t/ha of lucerne pellets had been incorporated at 30-40cm depth and found that the 30-40 cm clay layer was now soft and friable, and made up of small aggregates,” he said.

“This clay layer had been completely transformed and looked like topsoil, and in contrast the clay layer at this depth in the control plots was still dense and hard.”

HOW SUBSOIL MANURING WORKS

The incorporation of the organic matter into the clay subsoil increases microbial growth in the amended soil. Microbial exudates are then produced, and these enable clay particles to form into small aggregates. This provides pore space that contains plant-available air and water, which enable the roots to grow in the subsoil and utilise the nutrients released from the organic matter.

These roots then release more root exudates (sugars and amino acids) into the soil, which further feed the soil microbes that continue to increase the aggregation of the clay particles – and the cycle continues.

The appearance of the 30-40 cm subsoil clay layer, four years after lucerne pellets had been incorporated in the layer (B), compared to the clay layer in the control soil (A) at a field site in Ballan.
Assisting growers achieve yield potential in the HRZ of south-eastern Australia

DAV00083 2010
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Management of High Rainfall cropping to improve Water Quality

DAV00059 2009
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Delivering high yields of milling wheats in the HRZ in WA

CSP00065 2008
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Evaluating the potential for dual purpose (grain/graze) canola in the mixed farming systems of southern Australia

CSP00085 2010
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Investigating stubble management systems to reduce dependence on burning in the HRZ region of Sth Australia

SF500014 2008
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Genotype and management combinations for highly productive cropping systems in the HRZ of Sth Australia

DAV00051 2007
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Increased farm profits in the HRZ using mixed cropping/ grazing systems

CSP00099 2007
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Understanding sub-soil constraints in the HRZ

DAV00056 2006
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Environmental impacts of raised bed cropping in south-west Victoria

DAV417 2005
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Scoping study for further trials on atrazine use in raised bed farming

NSP00001 2008
Natural Solutions
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Change in soil properties under raised bed cropping

UM148 2005
Professor Robert White
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Optimising cereal profitability in the HRZ through integration of disease management

SF500015 2008
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Wheat breeding for HRZ of Australia

CSP00019 2007
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Breeding dual purpose feed wheats for the high rainfall zones

CSP00101 2010
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Optimising economic yield responses through disease management in winter cereals

SF500006 2005
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Pest suppressive landscapes: linking IPM and natural resource management

CSP00051 2010
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Dual purpose crops in the HRZ

CSP00132 2012
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Biodiversity management in high-intensity agricultural landscapes for conservation and provision of ecosystem services

CSP00134 2013
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Maximizing crop yield in the HRZ of WA through efficient use of water and nutrients

CSP00128 2012
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