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Farmers and scientists

move forward with knowledge

by Sarah Cole

Climate Champion farmers get top billing for National Press Club this month

NATIONAL PRESS CLUB OF AUSTRALIA

Australia's leading climate scientists and agricultural researchers will get the chance to meet the nation's Climate Champion farmers at a National Press Club event sponsored by the Grains Research and Development Corporation in Canberra on 21 March.

The National Press Club, a renowned Australian establishment where influential people initiate change, will set the scene for the next national Climate Champion program workshop.

The press event features a panel of scientists and producers, and will be facilitated by Sophie Morris, journalist at the Australian Financial Review. On the panel will be Snow Barlow, convenor of the Primary Industries Adaptation Research Network; Susan Findlay Tickner, Climate Champion and GRDC southern panel member; and Dr Shakeel Bhatti, Secretary of the International Treaty on Plant Genetic Resources for Food and Agriculture.

The Climate Champion program's national workshop, on the 21 and 22 March, has been timed to coincide with the press club event. The workshop gives the farmers an opportunity to exchange knowledge and ideas with Australia's top scientists about what is possible from climate research.

The workshop agenda includes the National Press Club address, a mini networking and research forum, four on-farm tours with presentations from leading researchers and farmers, Climate Champion program discussions, and media and presentation skills training.

The on-farm tours will include John Ive's award-winning superfine merino operation in the Yass Valley; Peter Holding's diversified winter-cropping, sheep and lamb enterprise at Harden; David Cattanach's much-researched grain farm in Coleambally and Pele Cannon's family beekeeping enterprise.

The Climate Champion program, an initiative of Managing Climate Variability and the Grains Research and Development Corporation, aims to narrow the gap between Australia's agricultural industry and research into climate.

The program also welcomes its latest member, cropper Peter Horwood from Mingenew, Western Australia. 'With the costs associated to be successful in agriculture, all enterprises —regardless of size and location—need to develop an increased understanding of climate: one of the most important factors of which we can't control. With increased understanding, by even a small percentage, outcomes will improve', he says.

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MANAGING CLIMATE VARIABILITY R & D PROGRAM

Farmers love the 'show and tell' nature of annual workshops

With the next Climate Champion workshop this month, Climate Champion farmers and top climate scientists alike are priming themselves for yet another information-packed five-day program of workshops and farm visits.

Climate Champion participant Pele Cannon says the workshops are a great way to connect with others in the program, share their experiences in managing climate variability, and draw inspiration and motivation from fellow farmers.

'The workshops have also become a way to build more collectively on the aims of the program, and collaborate and discuss ideas with other Climate Champion farmers', she says.

In October 2011, the Climate Champion farmers visited farms and trial sites in northern New South Wales and south-east Queensland. The on-farm visits at Moree, Lockyer Valley and Tweed Heads were a highlight of the tour.

The farmers heard from three fellow members of the Climate Champion program about the innovative practices, management decisions and trial research that help them to manage climate variability in their enterprises.

Farmer feedback from the workshop included comments such as, 'It is great to see and hear about innovative practices that really work.'

Feature topics at the workshop included communicating climate variability, the aims and outcomes of the program, and farmers' practices and strategies to deal with climate variability.

Leading climate and farming-systems speakers who presented at the workshop included:

- Professor Snow Barlow (Convenor, Primary Industries Adaptation Research Network)
- Dr Peter Carberry (CSIRO Deputy Director, Sustainable Agriculture Flagship)
- Peter Deuter (Senior Principal Horticulturist, Agri-Science Queensland)
- Catherine Ganter (National Climate Centre, Australian Bureau of Meteorology)
- Stephen Harper (Horticulturalist, Department of Employment, Economic Development and Innovation)
- Dr Anthony Kiem (Environmental and Climate Change Research Group, University of Newcastle)

Apart from the farm visits and the chance to gain insight into current Australian research, the farmers also discussed the goals of the Climate Champion program. The four key goals that they developed and have subsequently worked on are:

1. creating a succession plan for the Climate Champion program so that its value continues into the future
2. writing fact sheets for farmers and briefing papers for politicians about important climate/agricultural research areas
3. promoting the Climate Champion program to Australian researchers as a valuable source of symbiotic climate/agriculture projects and collaborators
4. working with climate-communication researchers and practitioners at the next workshop to increase their knowledge and skills in this area.

Climate Kelpie —ask an expert

by Tom Dixon

Need to ask a question about your local climate, but not sure who to ask? Climate Kelpie can help you!

Climate Kelpie is a website for rounding up information and tools for Australian farmers. You can learn about weather, regional climate, and find decision-making tools for climate risk management.

Content is written from interviews with farmers, climate experts and scientists interested in improving agricultural practices in the face of increasing climate variability. A key feature of Climate Kelpie is to provide you with links to farmers and experts who can answer specific questions about climate.

For example, if you're a grain farmer from Victoria, you could contact Susan Findlay Tickner. Susan is a participant in the Climate Champion program, and grows wheat, lentils, chickpeas, barley, beans and fodder on a dryland farm in the Wimmera (north-western Victoria).

Climate Kelpie website page Ask an expert.

Susan joined the program so that she could get more growers talking about climate, learning about how it might affect them and sharing their experiences in managing cropping practices. She also thinks it is important farmers have current and accurate information on research and innovation.

Susan describes how she tackles the challenges of a variable climate by monitoring soil moisture, carefully managing crop nutrition and fertiliser, retaining stubble, using no-till methods and inter-row sowing.

Susan, like other farmers in the Climate Champion program, has a full profile on Climate Kelpie and is happy to answer any questions about broadacre farming, climate, managing climate into the future and risk in her area, and future plans for her property.

If you want to submit a specific question, and have found a Climate Kelpie profile of a farmer that you'd like to contact, you can contact them directly via their farmer profile page.

If you are unsure if there's anyone in a similar situation, or you need to contact an expert or advisor in your area, simply submit a question via the 'Ask a question' section of the website, and we'll find the expert for you.

Adapting primary industries to changing climates —the big picture

Professor Snow Barlow, convenor of the Primary Industries Adaptation Research Network, generated keen interest among farmers at the Climate Champion workshop last October.

Prof. Snow Barlow talked to Climate Champion farmers about current issues of extension and information transfer.

Lynne Strong—dairy farmer at Jamberoo (NSW) —met with the Minister for Agriculture, Fisheries and Forestry, Senator the Hon. Joe Ludwig on her farm in late October. 'The Minister sees the Climate Champion program as a benchmark for cross-industry collaboration and partnerships. It was awesome to be able to show him around the farm and hear his passion for nurturing young farmers', Lynne says.

'Snow's talk was a good discussion and a great example of what farmer/researcher interaction can be like', one farmer said.

Prof. Barlow and the Climate Champion farmers talked about current issues for primary industry in the face of increasing climate variability. Some of those issues include:

- Creating **better understanding between farmers and researchers** about what is and is not possible, both on the research side and on-farm, for agricultural research. For instance, farmers telling scientists what their priorities are, and farmers understanding what research is feasible.
- **Understanding how extension can be improved** in order to get useful research results back to farmers. Suggestions and discussion followed: should researchers talk directly to farmers? Should they give agribusiness agronomists updates on the latest research? Is it about taking politics out of the issues? Do farmers and agronomists need regional seminars? Should research questions focus on the money farmers can save by adapting their enterprises? Do farmers need independent funding to run trials that focus on their specific needs/questions?
- Learning how farmers can participate in potential carbon markets.

The Climate Champion farmers were recognised as one of three finalists in the 'Advancement of Climate Change Knowledge' category in the Australian Museum's prestigious Eureka Prizes. Check out their finalist page at: www.tinyurl.com/cpk6a7g

Project updates

The following table lists our current projects.

Project title	Time	Summary of research objectives	Progress to date	Research contact
Extremes, climate modes and reanalysis based approaches to climate resilience Final report submitted	2008 –11	Use atmospheric reconstructions of the last century of worldwide weather to help manage extreme weather events in Australian agriculture. Management options include adaptation, insurance, seasonal forecasting and future strategic projections for heatwaves, hail and other exceptional circumstances.	Index insurance in Australia is in its infancy and may need public¬–private partnerships to develop it as a useful alternative to existing disaster measures. Persistent extremes such as heatwaves and prolonged rain or drought are well characterised and sufficiently associated with a combination of climate indices to make climate index insurance a viable option. Very short-term extremes such as hail are not as well treated and may have to await future, higher-resolution reanalysis.	**Dr Peter Best** University of Southern Queensland cindualpk@bigpond.com 07 3844 1777
Assessing and managing heat stress in cereals	2008 –13	Investigate the meteorology and climatology of spring heat events on the southern grains wheat belt. Develop a risk management package for growers.	Researchers are examining the weather patterns and climate drivers behind heat events. Last spring, heat chambers were applied at 2 different wheat crop growth stages at Roseworthy, 50 kilometres north of Adelaide. For each heat event there were 6 chambers heating 6 different plots, with another 6 defined as control plots with no heating. Soil samples were taken in all treatment and control plots directly after heating ceased. Results show no difference between plots. The resulting wheat yields are being analysed.	**Dr Peter Hayman** South Australian Research and Development Institute peter.hayman@sa.gov.au 08 8303 9729
Teleconnections between climate drivers and regional climate, and model representation of these links	2010 –13	Improve Australia's dynamical forecasting by investigating the connection between rain-bearing weather systems and remote climate drivers, including the El Niño – Southern Oscillation, the Indian Ocean Dipole, the Madden Julian Oscillation, subtropical ridge and Southern Annular Mode.	Rossby waves play a key role in the atmospheric teleconnection between climate drivers and local weather systems. However, calculations of the Rossby wave ray path indicate that these waves, generated by convection in the Indian Ocean, cannot propagate southwards of the subtropical jet. Sophisticated diagnostics such as wave activity flux and Rossby wave source calculations are being used to try and solve this puzzle.	**Dr Peter McIntosh** Centre for Australian Weather and Climate Research Peter.Mcintosh@csiro.au 03 6232 5390
Improving forecast accuracy through improved ocean initialisation	2010 –13	Improve predictions of conditions in the Indian Ocean and ultimately predictions of regional climate for western, southern and eastern Australia.	Improvements in POAMA-2 skill compared to POAMA-1.5 were largely due to a better representation of ocean salinity. The improvements in skill were mainly in the tropical Pacific, where salinity plays a larger role. In the Indian Ocean, improvements in skill were limited to the ocean sub-surface, resulting in little impact on regional climate. Improving the ability to predict the Indian Ocean variability is key to predicting regional climate in Australia. Further improvements in skill will only come with adding new enhancements to POAMA. The next phase of the project will look at the impacts of enhancing the way we initialise the model and adding new observing systems.	**Dr Oscar Alves** Centre for Australian Weather and Climate Research O.Alves@bom.gov.au 03 9669 4835

Project title	Time	Summary of research objectives	Progress to date	Research contact
Improving multi week predictions	2009 –12	Improve POAMA's weather predictions for 2–8 weeks ahead to make them more useful to agriculture and water management industries.	POAMA has been successfully upgraded to version 2, including specific enhancements aimed at multi-week forecasting. The multi-week forecasts of temperature and rainfall over Australia in this version are more skillful and reliable than those from POAMA-1.5, and there is higher skill in predicting the Madden-Julian Oscillation, the Southern Annular Mode and atmospheric blocking. In the coming months, researchers will continue to examine the climate drivers that control climate variability on multi-week timescales and which influence the skill of the forecasts. Work is also underway to produce experimental multi-week products on the POAMA website (www.poama.bom.gov.au) to get feedback from users.	**Dr Debbie Hudson** Centre for Australian Weather and Climate Research D.Hudson@bom.gov.au 03 9669 4796
Understanding frost risk in a variable and changing climate	2010 –12	Improve understanding of the variability and changing nature of frost risk at both seasonal and decadal scales for the southern regions of Australia, and implications for the wine and grain industries.	The analysis of comprehensive climate data from 18 locations across southern Australia has identified consistent patterns of change in the frost window, such as a broader time frame in eastern parts of Australia and slightly later seasonal occurrence in western parts. Ongoing analysis of 20 years of data from 6 Victorian and 9 WA sites are showing that late frosts in September–November occur in association with high-pressure systems situated to the west and south of the region of interest	**Dr Steven Crimp** CSIRO Steven.Crimp@csiro.au 02 6242 1649
Multi-week forecasting products (for the Water and the Land website)	2010 –13	Using multi-week forecasts identified under the Improving multi-week predictions project, make new forecasting products available on the Bureau's Water and the Land website. The products will be tested by farmers participating in Managing Climate Variability's Climate Champion program.	A set of calibrated multi-week demonstration forecasts have been produced and an online survey distributed to the Climate Champion participants to provide feedback. Further communication with the Climate Champion participants occurred at a workshop during October 2011. As a result of their feedback, maximum and minimum rainfall forecasts will be removed from the suite of products, due to the sizeable difference between the two values. Producing these forecasts was felt to be of little to no benefit, with resources better used elsewhere.	**Dr Andrew Watkins** Bureau of Meteorology A.Watkins@bom.gov.au 03 9669 4360
Understanding frost and heat stress extremes in the WA wheat belt	2010 –13	Quantify the extremes and impact of frost and heat stress on the WA wheat belt. Link with the frost and heat stress projects underway in SA and Vic to improve understanding of frost and heat stress across southern Australia.	Better simulations of regional variation of temperature extremes and weather patterns for both current and future climates have been made using Murdoch University's Weather Research and Forecasting regional model. Experiments for 3 grain areas of WA have been designed, and APSIM has been set up to study temperature extremes and analyse the risk associated with its occurrence. The analysis of historical temperature risks in WA has commenced.	**Dr Ian Foster** Department of Agriculture and Food, Western Australia Ian.Foster@agric.wa.gov.au 08 9368 3333

Weather forecasting: it's complex

by Robbie Mitchell

Southern Mallee grain grower David Smith knows that despite the great improvements over the past decade or so, weather forecasts still have limitations.

He recounts a time where he had been following a weather forecast for seven days so he could calculate when to spread urea before a promised rain front would arrive to water it in.

'We had most of the urea spread before the first rain event and thought we'd spread more because another front was supposed to come through. The next day the live forecasts were all saying the rain was still coming but we could see it was long gone.'

It's a story we can all identify with, even with the improved skill of weather forecasts. So why can't the forecaster get it right every time?

Follow the progress of Dr Peter McIntosh's MCV project 'Teleconnections between climate drivers and regional climate, and model representation of these links' in the Project Updates (pages 4–5).

Dr Peter McIntosh from the Centre for Australian Weather and Climate Research says the accuracy of weather forecasts in Australia is limited by three things: the inability to make detailed atmospheric and oceanic measurements, the finite power of the computers, and an incomplete understanding of complex processes in the atmosphere.

Improving measurements

'In order to conduct a weather forecast you need to know exactly what the weather is at a given point in time. If your measurements are not exact then the errors in your primary calculations will snowball when you use them to predict future weather patterns. This is a form of chaos—where initial errors grow', says Dr McIntosh.

'This process has improved considerably in the last 30 years with advanced weather analysis and prediction, and weather forecasts are generally quite accurate out to 5–7 days.

'What needs to be remembered, though, is we'll never predict individual weather events with total accuracy past about 14 days. That will be the absolute limit. What happens is you cannot measure accurately enough the current state of the atmosphere, land and oceans.

'So errors will always be there and those errors will eventually degrade the accuracy of a weather forecast. Beyond about 14 days, we have to rely on climate forecasts of average weather conditions, such as those made by the Predictive Ocean Atmosphere Model for Australia.'

Improving computers

All the information that meteorologists gather from ground stations, weather balloons, aeroplanes, satellites, ships, buoys and other observational points is fed into computers, checked for accuracy, and mapped onto a three-dimensional grid which covers Australia. Each grid point represents a snapshot of atmospheric pressure, temperature, moisture and wind speed for that area.

In the 1970s, meteorological modellers divided the country into a 500-kilometre grid and performed calculations at nine levels of the atmosphere.

Today they use a 75-kilometre grid and around 30 levels are incorporated.

This improvement is inherently linked to advances in computer technology. Faster computers allow more grid points to be used and finer scale weather features to be modelled. However, it will still be many years before we will be able to reduce the grid nationally to 5–10 kilometres, the size of a large thunderstorm—relevant to farmers such as David, but almost invisible to weather models with a larger grid size.

POAMA-2 now available

Experimental POAMA-2 climate forecasts are available on the POAMA website (www.poama.bom.gov.au) on a range of timescales from one fortnight to several months into the future, and for both temperature and rainfall. These are available in a range of formats to allow users to evaluate their usefulness.

For more *Climag* articles on POAMA, see previous editions at the Managing Climate Variability website: www.managingclimate.gov.au/publications/

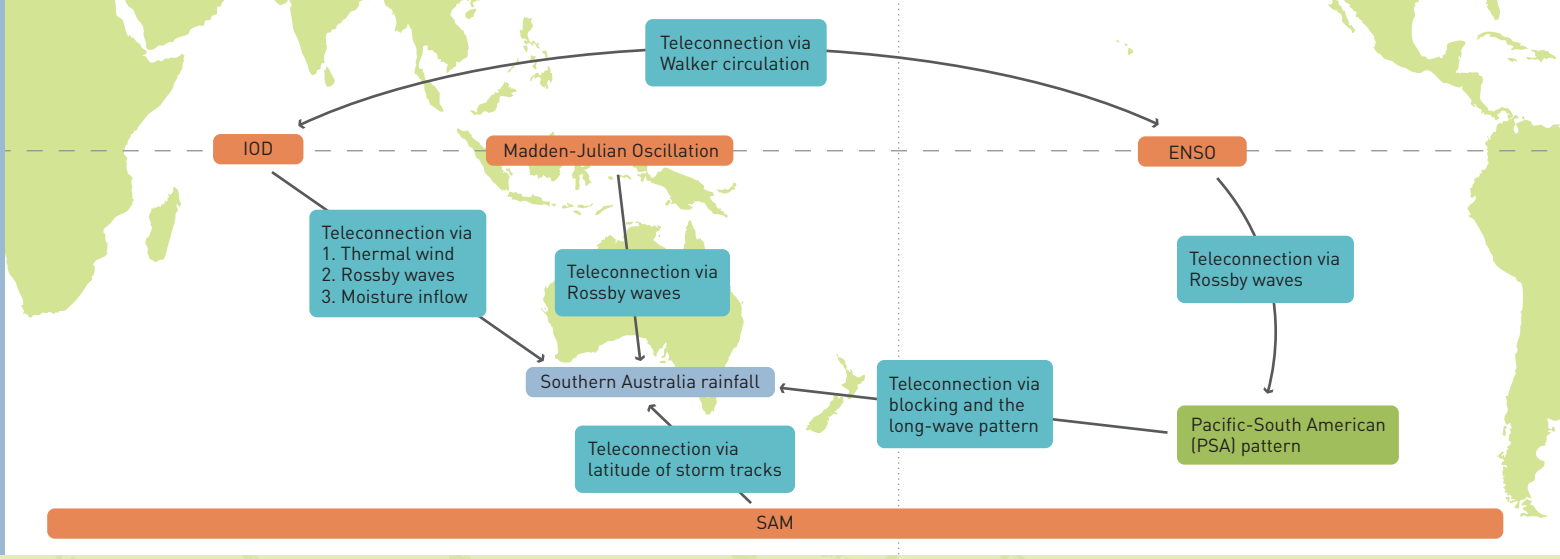

Figure 1: Conceptual map indicating our current understanding of the important remote climate drivers and processes affecting southern Australian rainfall. Arrows indicate the connection pathways between remote drivers and local rainfall, together with the probable dynamical processes responsible for these teleconnections.

Forecasting term	
Blocking phenomena	Leads to a stagnation of weather patterns from several days to weeks. In winter, blocking is often associated with cutoff lows which can cause substantial rainfall events. In summer, blocking often coincides with long-lived high pressure systems that might be associated with above normal temperatures and other weather extremes.
North-west cloud bands	Formed when tropical air from the Indian Ocean moves southeast and is forced to rise over colder air. They occur from mid-autumn to early spring and can bring extensive rain to inland, southern and eastern Australia.
Cut-off low	A cold-cored low pressure system seen at most levels of the atmosphere that is closer to the equator than the usual band of low pressure to the south. Commonly associated with blocking in winter, these systems are responsible for most high rainfall events, and about half of all rainfall in the southern growing season.

Table 1: Explaining forecasting terms

Improving knowledge of the atmosphere

Weather is influenced by a large number of interconnected systems originating in the atmosphere, ocean and land. Small changes in one part of the world can impact on the weather in another part—days, weeks and even years later. While we can model these changes, they are complex and have a random element.

'Australia is in a very interesting position in the world because we are affected by three very big oceans, and Indonesia is a strong source of convection', says Dr McIntosh.

'Our seasonal climate system is complicated, especially in the south-east and south-west of Australia. Distant tropical drivers like El Niño – Southern Oscillation, the Indian Ocean Dipole and the Madden-Julian Oscillation can alter the behaviour and pattern of rain-bearing weather systems, and these drivers can interact in complex ways. The Southern Annular Mode in southern latitudes complicates matters further.

Dr McIntosh says meteorologists are starting to realise the importance of:

- Rossby waves in connecting and driving these systems
- the role that atmospheric blocking plays in generating cut-off low rainfall (which provides 50 per cent of rainfall to south-eastern Australia), and
- what role, if any, north-west cloud bands play.

By understanding these drivers, Dr McIntosh and other meteorologists will be able to improve the accuracy of five-to-seven-day forecasts as well as the multi-week climate forecasts that are being made by the Predictive Ocean Atmosphere Model for Australia (POAMA).

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Rossby waves

Atmospheric Rossby waves are a bit like very large ocean waves in the upper troposphere (the level that commercial planes fly at). They can be seen as meanders [turns] in the familiar jet streams which push weather systems from west to east. Rossby waves also radiate poleward and eastward from tropical convection events to influence southern Australia's weather.

Like all waves, Rossby waves undulate and have troughs and ridges. Areas of low pressure typically develop in the troughs of the waves, while high-pressure areas form in the ridges. As the waves meander, these troughs can grow to become approximately 8000 kilometres apart.

When the waves are well developed and cover a wide range of latitude they are said to have a 'low zonal index', which leads to the formation of ridges of slow-moving or stationary high-pressure systems (blocking) and dry, stable conditions.

When the waves are almost straight and cover a narrow zone of latitude they are said to have a 'high zonal index', which leads to a succession of low-pressure systems and unsettled weather.

The wave evolution cycle lasts about six weeks but can be disrupted when blocking highs slow down the wave and divide the jet stream. This can seriously disrupt weather patterns and has been linked to causing extreme dry conditions in one part of the world and extreme wet conditions in another.

Growers remain cool

in the face of extreme heat

by Mary O'Callaghan

With temperatures projected to rise by around one degree (on average) by 2030, and more very hot days per year likely, growers need to know if and how they can adapt. Both horticultural and broadacre crops are sensitive to changes in temperature. Yet, temperature thresholds for horticultural crops are not well known, especially for vegetables, and the impact of heat on wheat has up to now only been trialled in the lab.

Critical temperature thresholds for vegetable crops

'Horticulture contributes around $7 billion annually to the Australian economy', says Peter Deuter from Agri-Science Queensland. 'Most of horticulture is irrigated, so rainfall and run-off into irrigation storages are important, but it is temperature that determines, to a great extent, the location and performance of most horticultural commodities. So it is critical that we understand the specific impact of temperature change on commodities.'

Mr Deuter and his project team have reviewed the literature and consulted industry to determine critical temperature thresholds for 12 major horticultural commodities (Table 1).

About two weeks before harvest, an iceberg lettuce starts to develop its heart. The crisp leaves of the firm, compact, spherical heart are firmly packed in the head. Temperature is critical during this phase and if the mean monthly maximum temperature exceeds 28°C, the heart will not be as strong and firm as it should be. This reduces the overall quality of the lettuce.

Lettuce is just one of more than 100 horticultural crops grown in Australia, each with its own critical temperature threshold, which can differ between different varieties.

A critical threshold is the point at which production becomes unviable. In horticulture, yield and/or quality are usually the first to suffer as the threshold is approached or exceeded.

Temperature affects horticultural crops in many ways, including influencing the timing and reliability of plant growth, flowering, fruit set and ripening, and product quality.

For some crops, higher temperatures will affect pollination, and fruit size and quality. Avocados, for example, will be smaller and the length of time they can be 'stored' on the tree will be shorter. Capsicum flowers will abort when temperatures exceed 32°C.

Production timing will also be affected as crops develop faster and mature earlier. By 2030 the mean maximum temperature at Gatton, Queensland, is expected to exceed 28°C from early October through to mid-April. This will shorten the winter lettuce season by 3–4 weeks.

Bananas, on the other hand, can withstand temperatures up to 38°C, so growing conditions in more marginal sub-tropical regions, such as New South Wales, are likely to improve.

Table 1. Critical temperature thresholds for selected horticultural crops

Crop	Development phase	Critical temperature threshold
Apple	Dormancy	Chilling requirement—cultivar specific
Avocado	Flowering and fruit development	33°C
Banana	Fruit maturity	38°C
Capsicum	Flowering	32°C
Cauliflower	Curd [head] induction	22°C
Citrus	Early fruit development	30°C
Lettuce	Hearting	28°C mean maximum
Macadamia	Retention of racemes [group of flowers on a stalk] and nuts	Declines rapidly >30°C
Pineapple	Flower initiation and pre-harvest	>35°C
Pumpkin	Flowering	>35°C
Sweet corn	3–4 weeks post flowering	32°C
Tomato	2-week period pre-anthesis [before the flower opens]	29°C mean maximum

Peter Hayman and Climate Champion participant and grain grower Kym Fromm discuss the impact of heat on wheat at a South Australian Research and Development Institute trial site.

Spring heat affects flowering wheat

Grain growers in South Australia are already feeling the heat. Many will recall 12 October 2004, an unusually hot day across the state. Adelaide's maximum temperature reached 37.4°C—the average maximum for October is 21°C. Some agronomists estimated the yield loss at 50 per cent. Severe heat events also occurred in 2009, in early- and mid-November.

Are growers likely to see more of these hot spring days? And what is the impact on the crop?

'Risk is the product of likelihood and consequence', explains Dr Peter Hayman (from the South Australian Research and Development Institute), who has been exploring the synoptic systems leading to spring heat events in the southern grain belt.

'Heatwaves are low-frequency but high-consequence events, making them challenging for climate scientists to predict and characterise, difficult for impact scientists to study and for farmers to manage.

'Unlike frost and many rain events, heat events tend to be widespread due to the large synoptic systems driving them.

'In the south-eastern grain belt, a heat event in spring coincides with a high pressure system to the east of Australia and a cold front approaching from the west. This combination leads to a northerly flow of air, bringing hot conditions, followed by a south-westerly, which brings cool conditions or even a frost.'

The impact of heat on wheat has often been measured in the lab. Working with the University of Adelaide, Dr Hayman has taken trials into the field for the first time.

'Using inexpensive, portable chambers we were able to control the air temperature around the wheat heads to a range of set temperatures up to 35°C.'

The team heated each wheat plot for just a single day and at a different time during the season.

'We found that yield was affected the most when we turned up the heat during flowering. As it gets later in grain-fill and closer to ripening, the plant can cope better with heat stress. During flowering, a single hot day of 35–36°C can decrease yield by as much as 20 per cent.'

Temperature is critical during the period when the heart of the iceberg lettuce is forming.

What can growers do to adapt?

To reduce their exposure to the risk of a hot spring day, some wheat growers are choosing varieties that flower earlier, closer to the milder conditions of early spring. Another option, says Dr Hayman, is to sow earlier so that the crop is flowering earlier in the year. 'In frost-prone areas, farmers have to be careful that they balance the risks of both frost and heat stress at flowering.'

It's a similar story for horticulture. As temperatures continue to rise in all vegetable production regions, Mr Deuter says that growers are likely to change planting and harvest dates, and shorten the production season by a few weeks.

Many horticultural regions have already experienced a rise in both maximum and minimum temperatures compared with 1961–90, he says, so growers have already experienced a rise of up to 1°C.

'Growers have adapted quite well, in general, through changes in production practices, timing of production and marketing', says Mr Deuter.

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Mobile applications
increasingly enriching farmers' timely decisions

by Alison Binney

BIG has always mattered in the farming business—be it the size of the machinery, the herd, the harvest or the profit. Yet more and more, ready access to the small intricacies of information is becoming the differentiating factor for farmers.

Developers of mobile technologies and satellite mapping systems are helping farmers to access information in ways that enable them to manage fine details concerning their land, machinery, yield, income, environmental impact and the climate.

In early 2011, in edition 20 of *Climag*, we introduced the smartphone climate analyser application ('app') that Dr David Freebairn from the RPS Group is developing for the Managing Climate Variability program (MCV). The climate app, due to be launched this year, will help farmers answer the questions: 'What are the chances of getting either x amount of rain, x degrees of temperature or x degree-days heat sum between any two dates?'

These are two screenshots taken from the prototype version of the climate analyser smartphone application being developed for MCV. The application will be initially available only for iPhone until the concept is fully established.

Barely a year since that article, the number of mobile applications targeting on-farm management across Australia has started to multiply. This rapid spread of information and communication technologies presents a wealth of opportunities for Australian agriculture to show leadership in climate change management and adaptation.

Climate Champion farmer Jennie Hawkins, who calls herself the 'IT manager' at her Finley property in southern New South Wales, says the capacity of the technology for improved on-farm management is huge.

Jennie has had her smartphone for just 12 months and she says there is a definite need for more farmer engagement on the potential of smartphones. Jennie says she is starting to research most of her business decisions using the smartphone.

'Depending on the season or the crop, or whether we're spraying, harvesting, fertilising or shearing, they can be big decisions', says Jennie of her reliance on the smartphone for information. But when it comes to the bigger influence that weather has on a decision, she says, 'We tend to confirm and access information with the home computer for better clarification.'

Fellow Climate Champion farmer Royce Taylor says he also makes 'reasonable' decisions using apps on his nine-month-old smartphone that influence the day-to-day running of his farm.

'My phone gives me access to up-to-date information, mainly in regard to marketing my grain, whenever and wherever I happen to be. I receive a large number of texts every day giving me up-to-date prices on all my commodities —grain, sheep and wool', says Royce.

In December the Grains Research and Development Corporation (GRDC), the managing agent for the MCV, released a new app called GRDC Weeds: The Ute Guide. The mobile application is designed to assist in identifying the most common weeds in Southern Australia.

In partnership with the GRDC, the New South Wales Department of Primary Industries launched its CropMate VarietyChooser, also in early December. VarietyChooser is a decision tool to help farmers choose varieties of barley, canola, chickpea, oats, triticale and wheat.

Information for managing the climate

David Freebairn says a high adoption rate by farmers of new smartphone technologies will 'torpedo' forward farmers' access to better information.

'Mobile technologies are not all about making on-farm management more precise. The best thing about mobile apps is that they allow us to access information when we want it. In this way they enrich decisions that are timely', says Dr Freebairn.

The climate analyser app is at the prototype stage and David is excited about how users will be able to use data from the Bureau of Meteorology to answer contextual questions.

'The climate analyser is being designed to give better access to the best of the current tools, and then add the next level of convenience and cleverness.'

A 2010 report on *Decisions made by farmers that relate to climate change* says, 'Policymakers need to translate emerging knowledge on adaptive practices into user-friendly strategies, tools and practices that farmers can readily adopt ... There is a need to enable farmers to access and master these strategies, tools and practices' (published by the Rural Industries Research and Development Corporation).

Science coordinator for MCV, Dr Beverley Henry, says investment in weather and climate information technologies may be something MCV considers in more depth in future.

'Farmers make many decisions that rely on reliable climate information and the Managing Climate Variability program is investing in more accurate forecasts and more useful products. Technologies such as the climate analyser app will be a key way of taking these products to farmers, thus opening up opportunities and helping to manage climate risk', Dr Henry says.

What about the information overload?

When asked whether farmers spend too much time fussing over information as opposed to getting on with decisions, Royce says, 'I don't think I spend too much time micromanaging. I think I get better access to information to make more informed decisions.'

Simon Wallwork, on the other hand, says that while smartphones have made a good impact on farming practices, 'They need to be put aside at times as they can be distracting. There is potential for these technologies to overcomplicate management and take some of the intuitive decision-making away.'

Jennie Hawkins replies: 'I think that if we could run more short workshops on smartphone technology, they [farmers] would be better informed.

New climate blog condenses climate-specific information

Advisors and farmers who want information on the latest climate and agriculture research, news and discussions can now access it in one place—Australia's first climate and agriculture blog, Agri Climate Culture, www.agriclimateculture.com.au

The GRDC hopes it will help advisors and grain growers find the right information to adapt to and manage Australia's increasingly variable climate. Growers are encouraged to comment and share their views on the site, and can subscribe to monthly digest emails. It also features local and international news stories, videos, proposal calls for adaptation and mitigation projects, and updates on the Climate Champion program.

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What does Australia's carbon tax mean for agriculture?

By Beverley Henry,
Science Coordinator for
Managing Climate Variability

2011 saw the Australian Parliament pass two major pieces of climate change legislation, the Carbon Farming Initiative and Securing a Clean Energy Future. These new policies (summarised in Figure 2, page 12) have introduced a large number of new concepts and terms that are challenging for all sectors of the economy and community.

For the agriculture sector, there has been confusion on the extent of opportunities and costs for farmers. Considerable uncertainty remains but the impacts and requirements for farmer engagement are becoming clearer over time.

The carbon tax and agriculture

Under the Securing a Clean Energy Future legislation, a carbon tax will be introduced on 1 July this year, initially as a fixed price starting at $23 per tonne of carbon dioxide equivalent emissions (t CO2 e) with a transition to an emissions trading scheme in 2015.

About 500 of Australia's largest emitters will have to pay the carbon tax from 2012. This legislation is a major economic and environmental reform that will affect all Australians.

Agriculture will be exempt from paying for direct emissions.

This means that farmers will not have to pay $23 for each tonne of emissions such as nitrous oxide from fertilisers applied on farms or methane produced when cattle and sheep digest feed.

However, farmers will be affected by additional costs.

A price on carbon means that farmers will face higher prices for inputs such as electricity and nitrogenous fertilisers that take energy to manufacture. Modelling by the Australian Bureau of Agricultural and Resource Economics and Sciences estimates that income for some livestock and grain farmers may drop by up to 4 per cent in 2012–13.

Farmers will likely look to efficiency measures to minimise impacts but productivity growth will be a key to maintaining income.

Some farmers may also be able to earn income from trading carbon credits under regulations set out in the Carbon Farming Initiative.

[continued on page 12]

[continued from page 11]

The Carbon Farming Initiative

The Carbon Farming Initiative, which was officially launched on 8 December 2011, is an offset scheme that aims to provide incentives for farmers and other land managers to adopt new practices that reduce emissions or sequester carbon.

To earn carbon credits, any new practices or carbon farming projects must use a methodology approved by the Domestic Offsets Integrity Committee and farmers must be registered.

The government intends to provide information to farmers to help them assess the costs and benefits of entering into the offset scheme. Practical mitigation options are just starting to emerge but, in many cases, analysis indicates that the costs of participation may outweigh the benefit.

Practices that provide productivity gains will more likely prove attractive to farmers, independent of the carbon trading market —at least in the near term.

More research is urgently needed into viable mitigation strategies and systems for farmer participation.

More information can be found at:
www.climatechange.gov.au/cfi
www.daff.gov.au/climatechange/australias-farming-future

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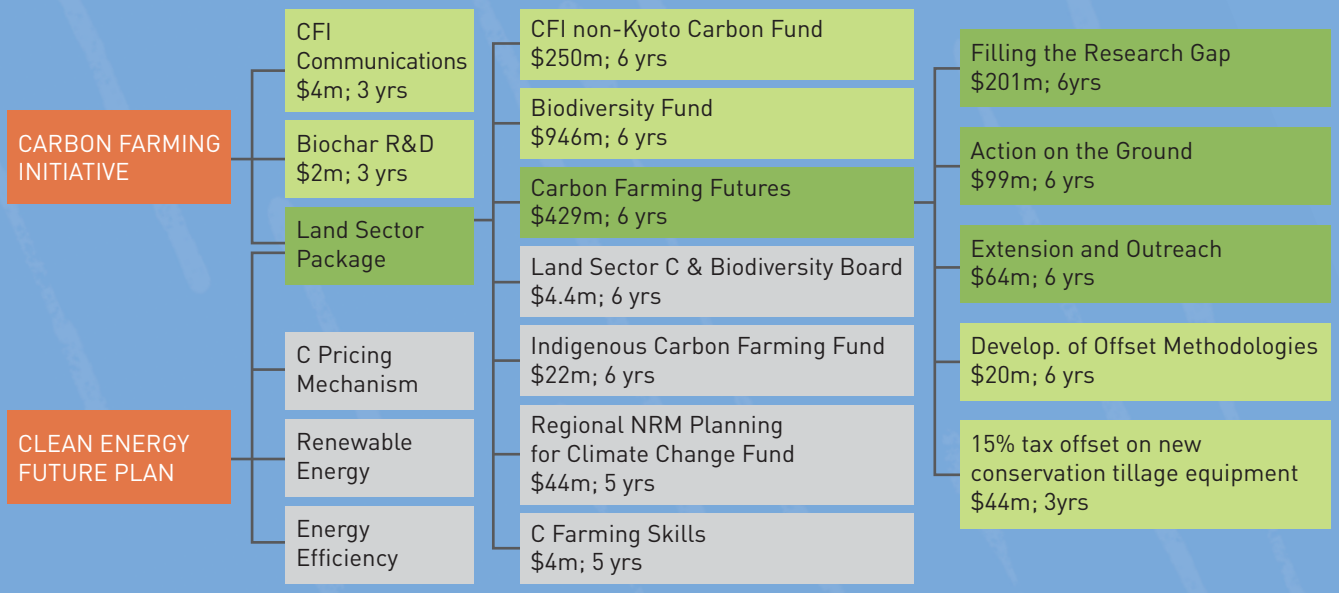

Figure 2: A summary of new climate change legislation passed in 2011. Green shading shows the components of most relevance to farmers.

Grains Research & Development Corporation

Australian Government
Department of Agriculture, Fisheries and Forestry
Rural Industries Research and Development Corporation
Sugar Research and Development Corporation

mla MEAT & LIVESTOCK AUSTRALIA

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For more information on Managing Climate Variability, visit www.managingclimate.gov.au

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