"Management of common sowthistle has increased in difficulty over the past 10–15 years across most of the cropping areas of northern NSW and southern Queensland," Richard said.

"There's a variety of reasons for this including that the weed appears to have adapted to emergence at any time of the year, the seed is easily wind dispersed meaning reinfestation of 'clean paddocks' is a constant challenge, and glyphosate tolerance and resistance levels have continued to increase.

"As researchers, it's critical that we keep ahead of the game so we can assist growers with accurate data on the weed's incidence and behaviour and offer management recommendations that are both practical and effective.

"Surveys enable us to build on our baseline knowledge, ensure that our sowthistle research projects continue to address growers' needs, identify any knowledge gaps and assess the effectiveness of extension activities.

"This type of information is paramount if we are to effectively control sowthistle in the future."

Responses in the recent NGA survey came from a variety of enterprise sizes with the total annual area of crop production among grower respondents ranging from 400 to 16,000 hectares.

The area advised on by the agronomist respondents was significant at 3.1 million hectares of country cropped annually.

Richard said the survey confirmed that research and extension activities were having a positive impact with 77 per cent of respondents saying NGA research activity had improved their knowledge of common sowthistle control, particularly with regards to double knock strategies, residual herbicides in fallow, alternatives to paraquat as a second knock option, alternatives to glyphosate and residual herbicides in crop.

"More than 70 per cent of respondents said that NGA research activity had changed their common sowthistle management practices," he said.

"In line with improved knowledge, practice change most commonly occurred in double knock strategies, residual herbicides in fallow and the use of alternatives to paraquat as a second knock.

"According to respondents, the major benefits from this practice change have been an improvement in the effectiveness and consistency of control, reduced weed populations, greater rotation and efficacy of herbicides."

The survey respondents placed a high importance on the use of residual herbicide, product choices for optical spot sprays and fallow knock down, and in-crop herbicide options.

But other non-herbicide control tactics are increasingly being used to support herbicides with practices such as competitive crop cropping strategies through increased plant densities, more vigorous crop types/varieties and narrower row spacing being used by 33–40 per cent of respondents.

Future research and extension of optical spot spray set up and usage, alternate double knock and in-crop knock down strategies, crop competition and harvest weed seed management were identified as opportunities to help growers effectively manage sowthistle.

The survey delivered some good news on the glyphosate resistance front with 66 per cent of respondents reporting that common sowthistle populations in more than half their paddocks were still susceptible to glyphosate.

Of the respondents who reported suspected glyphosate resistance, the vast majority said it existed in less than 10 per cent of their paddocks.

For more information on some of the current NGA common sowthistle research activities, download a copy of Richard's recent GRDC Update paper Common sowthistle – knockdown and double knock control in fallow from the resources and publications section of the GRDC website *www.grdc.com.au* or click here *https://grdc.com.au/resources-and-publications/grdc-update-papers/tab-content/grdc-update-papers/2019/03/common-sowthistle-knockdown-and-double-knock-control-in-fallow*

El Niño has rapidly become stronger and stranger, according to coral records

By Mandy Freund[1], Ben Henley[2] David Karoly[3], Helen McGregor[4] and Nerilie Abram[5]

THE pattern of El Niño has changed dramatically in recent years, according to the first seasonal record distinguishing different types of El Niño events over the past 400 years.

A new category of El Niño has become far more prevalent in the past few decades than at any time in the past four centuries. Over the same period, traditional El Niño events have become more intense.

This new finding will arguably alter our understanding of the El Niño phenomenon. Changes to El Niño will influence patterns of precipitation and temperature extremes in Australia, Southeast Asia and the Americas.

Some climate model studies suggest this recent change in El Niño 'flavours' could be due to climate change, but until now, long-term observations were limited.

Our paper, recently published in *Nature Geoscience*, fills this gap using coral records to reconstruct El Niño event types for the past 400 years.

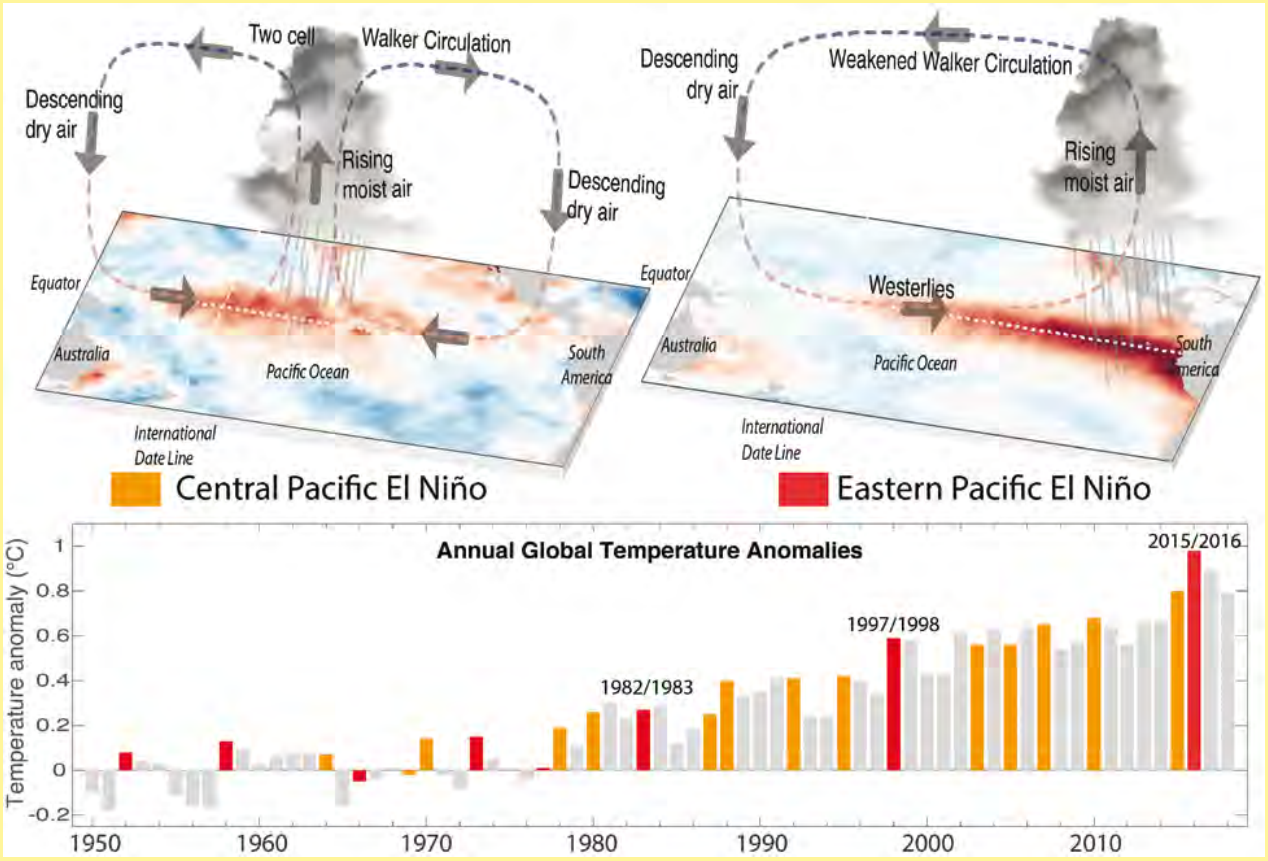
What is El Niño?

El Niño describes an almost year-long warming of the surface ocean in the tropical Pacific. These warming events are so extreme and powerful that their impacts are felt around the globe.

During strong El Niño events, Australia and parts of Asia often receive much less rainfall than during normal years. The opposite applies to the western parts of the Americas, where the stronger rising motion over unusually warm ocean waters often results in heavy rainfall, causing massive floods. At the same time many of the hottest years on record across the globe coincide with El Niño events.

The reason for such far-reaching influences on weather is the changes El Niño causes in atmospheric circulation. In normal years, a massive circulation cell, called the Walker circulation, moves air along the equator across the tropical Pacific.

FIGURE 1: El Niño and its global impacts



Schematic of idealised atmospheric and sea surface temperature conditions during Central (top left) and Eastern Pacific events (top right). Annual global temperature anomalies (lower panel) show the familiar upward trend due to climate change. Many of the hottest years on record coincide with El Niño events.