Managing variable benefits from enhanced efficiency fertiliser use in sugarcane production

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Sugar Research Australia

Project 2017/015

Concern

- Loss of dissolved N to the Great Barrier Reef
- Greenhouse gas emissions

- Loss of N to environment
- Reduced efficiency of fertiliser N use

Opportunity EEF

Nitrification inhibitors (NI)	Controlled release fertilisers (CRF)
• The inhibition of nitrification **keeps N in ammonium form** which is less mobile	• The controlled release of N aims for **better timing of N availability**

Reduces the risk of N loss to the environment

Increase yield or **reduce optimum N**

Photo: L.P. Di Bella

Problem 1

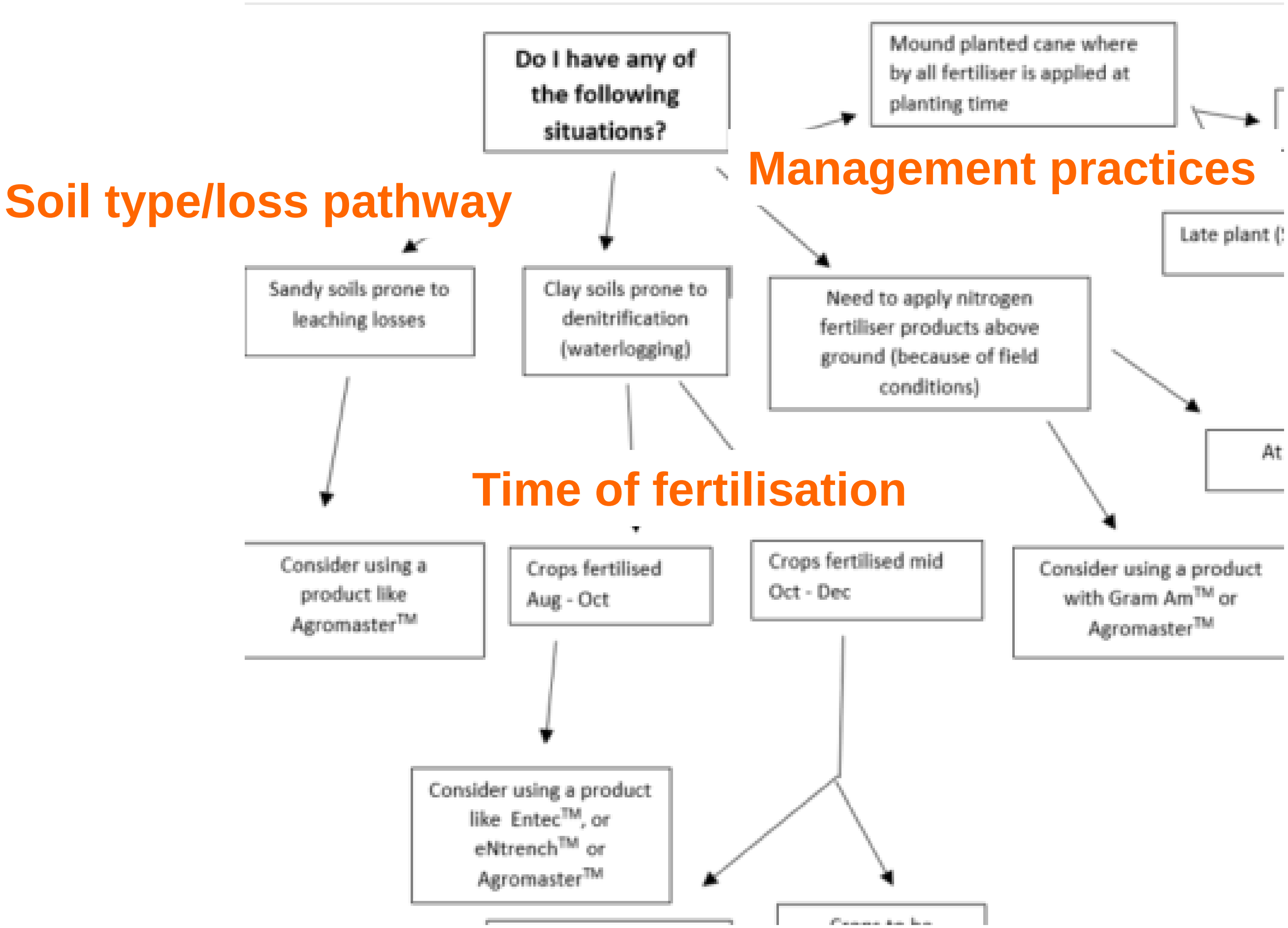
Benefits are **not consistent** season to season, soil to soil.

Even with perfect knowledge of optimum N there is large variability in response

Year	Δ Nopt	Δ Nloss
2005/06	0	1
2006/07	16	18
2007/08	8	10
2008/09	4	5
2009/10	50	52
2010/11	7	8
2011/12	104	114
2012/13	6	7
2013/14	2	4
2014/15	-1	0

Tully, reasonably well drained soil, low-medium N response, mid ratoon

Project aim: develop decision support logic



Fragment of original logic developed by HCPSL and revised during project

Problem 2

Benefits are proving **difficult to demonstrate experimentally**.

	Yes, convincingly	*No, or not convincingly*
	✓	✘
Yield (NUE) benefits	6	37
N loss benefits	5	3

*Based on a compilation of studies for Verburg et al (2016, ASSCT) and 2018 project milestone update

Consequence:

Limited experimental evidence to develop decision support

→ 'Virtual' trials to help fill knowledge gaps

APSIM model allows many options

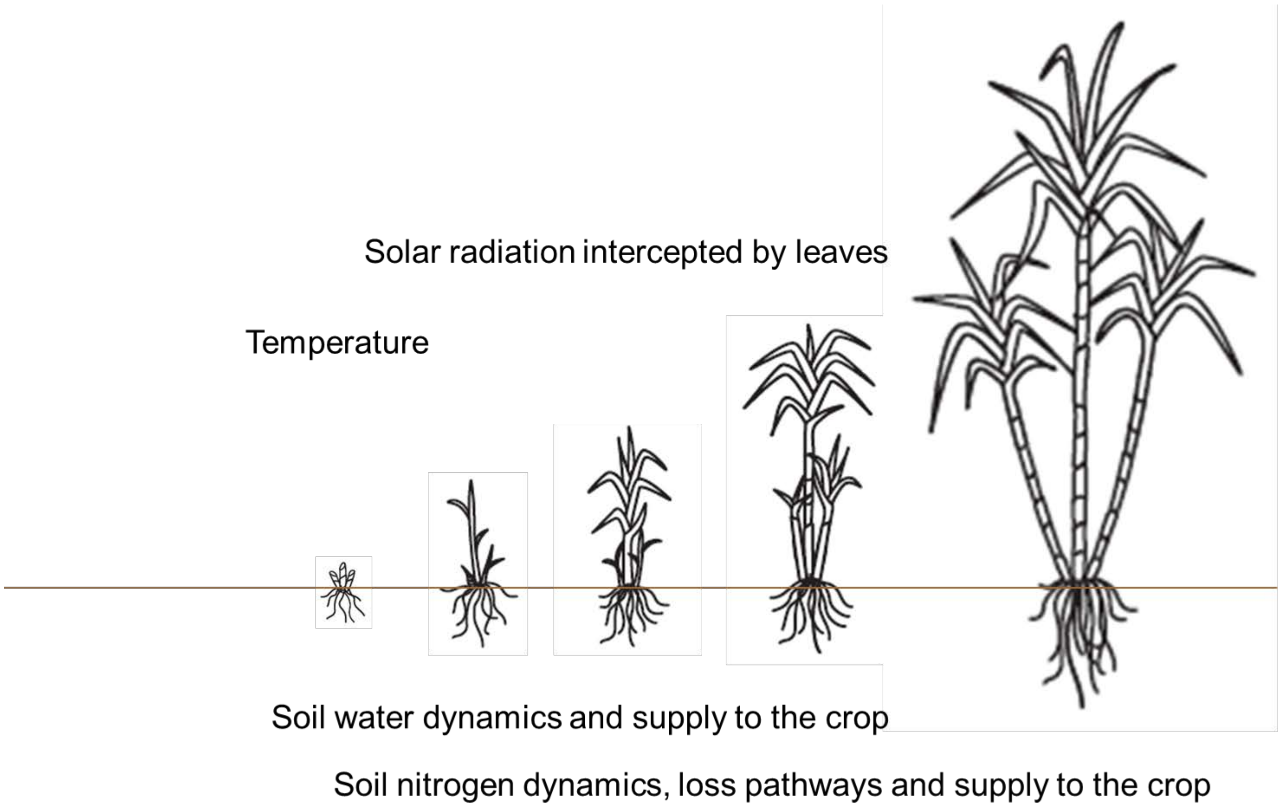
Crop

Fertiliser management

Irrigation management

Soil

Climate



Sugarcane diagrams from Bonnett (2014)

Modelling
Virtual trials

273,360

1 climate zone
10 soils
4 crop start times (July, September, November, December)
3 fertiliser types (urea, CRF, NI)
34 N rates (0-330 kg N/ha)
67 years

Each season is different

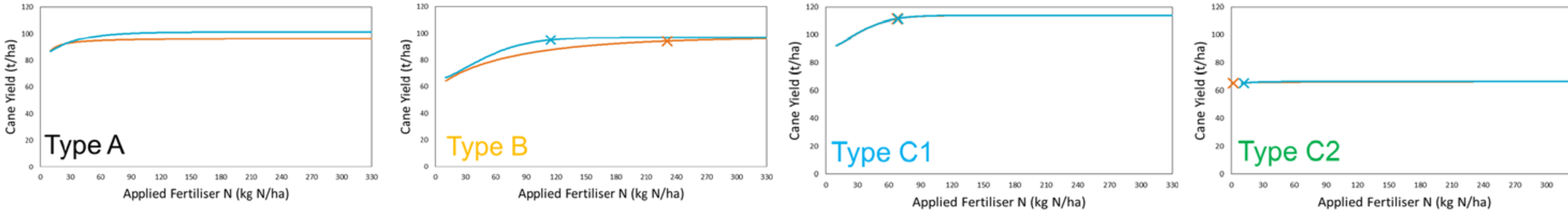
Classify responses

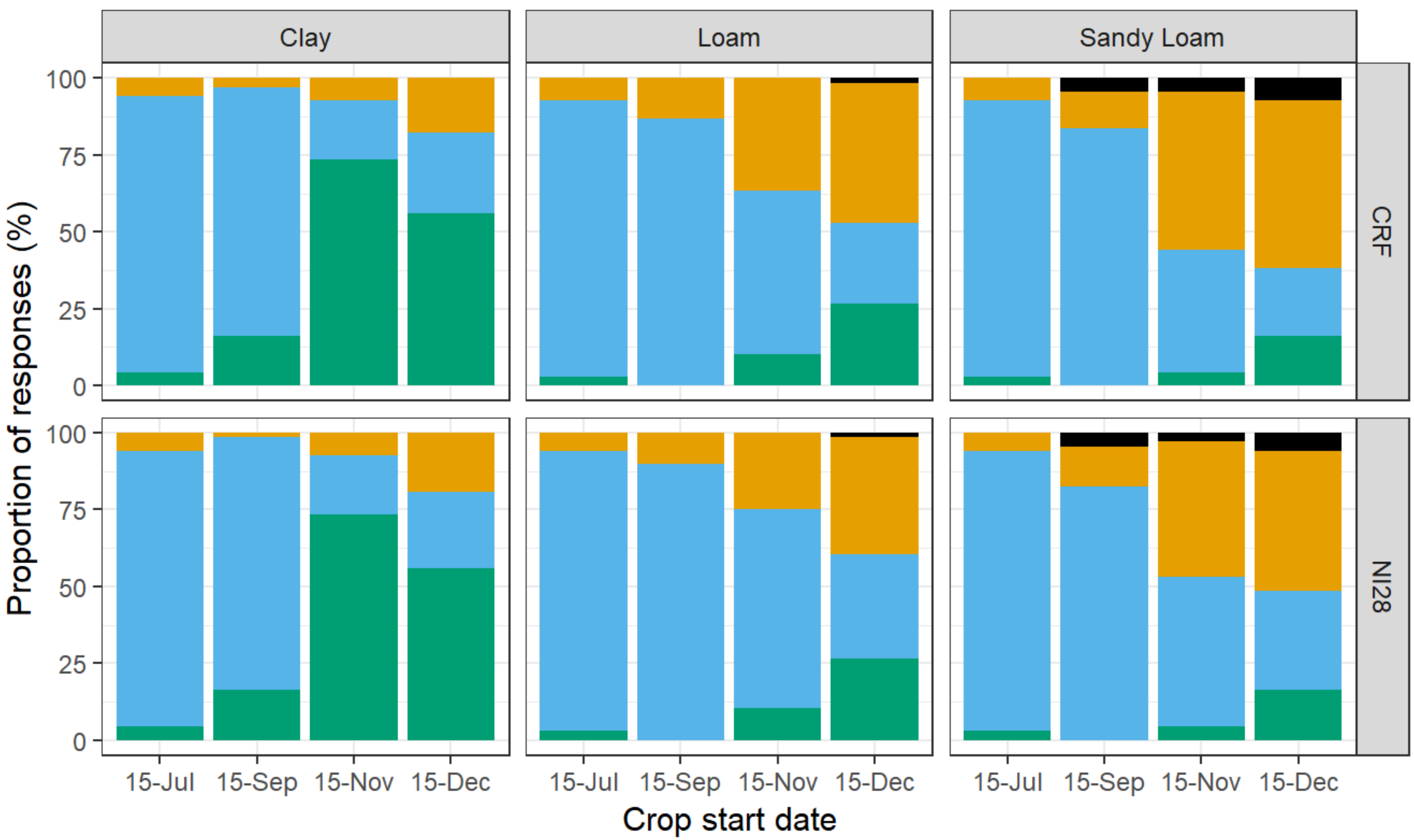
Identify circumstances leading to different responses

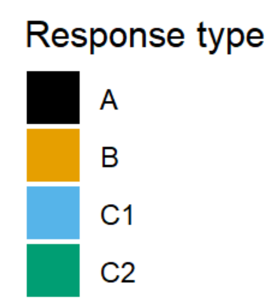
Likelihood response types

Verburg et al. (2019) ASSCT paper

Desired effects | No N loss | No N response

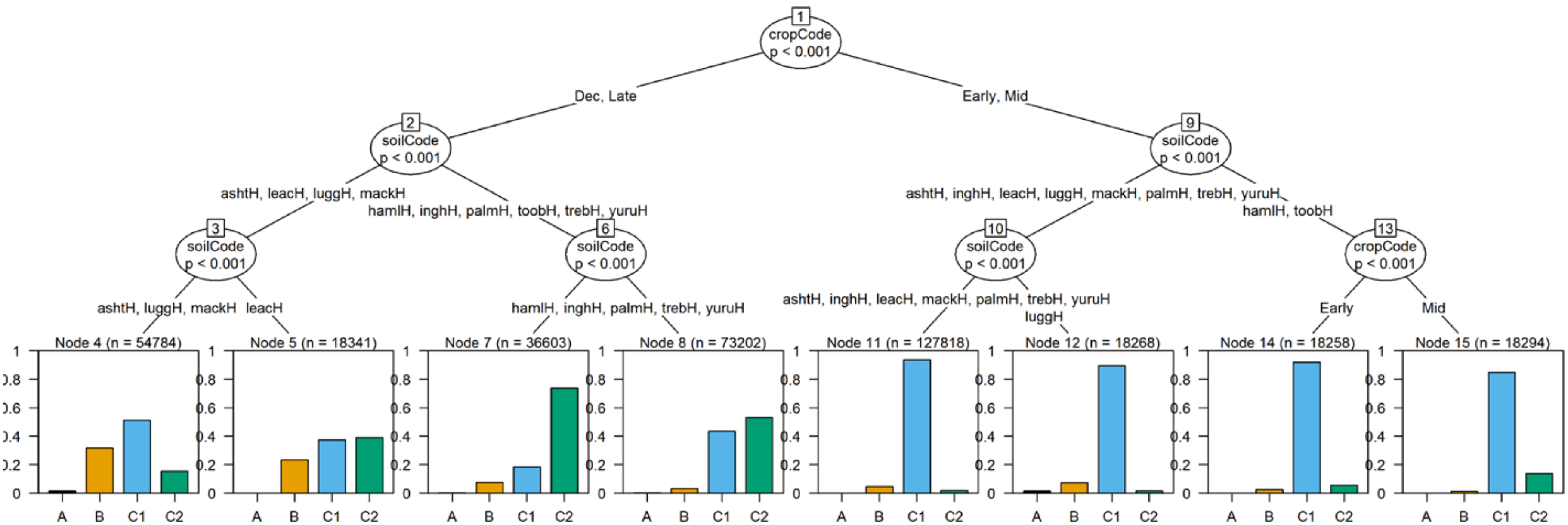






Note: results are soil type, landscape position and scenario specific; clay soil was experiencing water logging negatively impacting the crop's ability to use the N.

Developing decision support



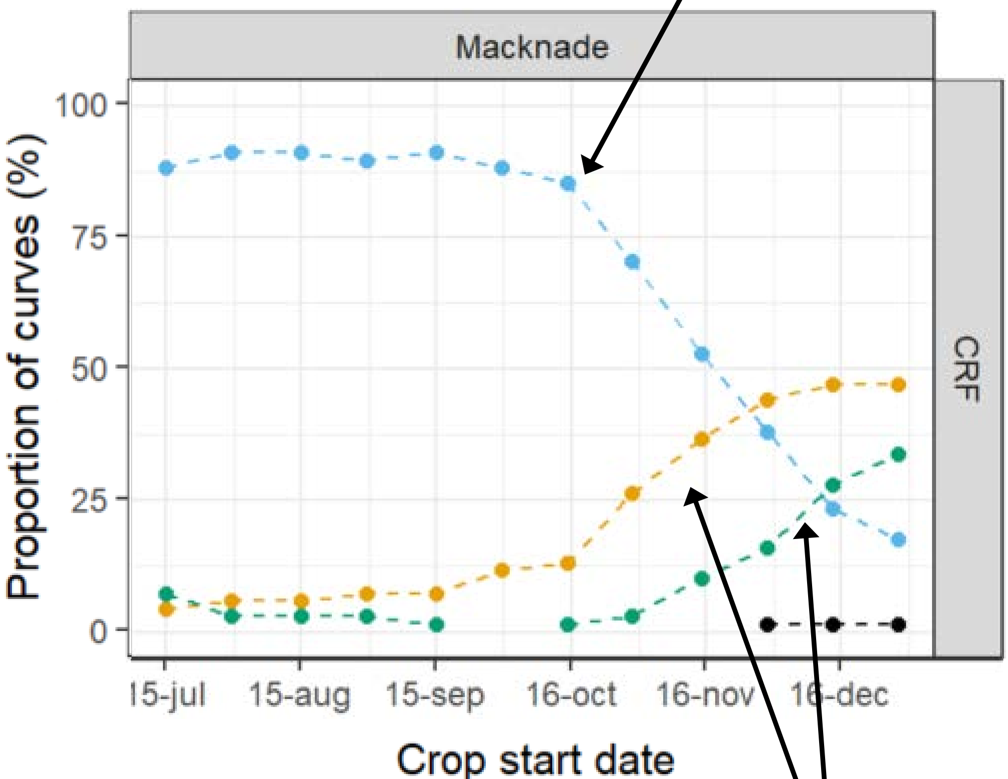
Further differentiation using
seasonal climate forecasting

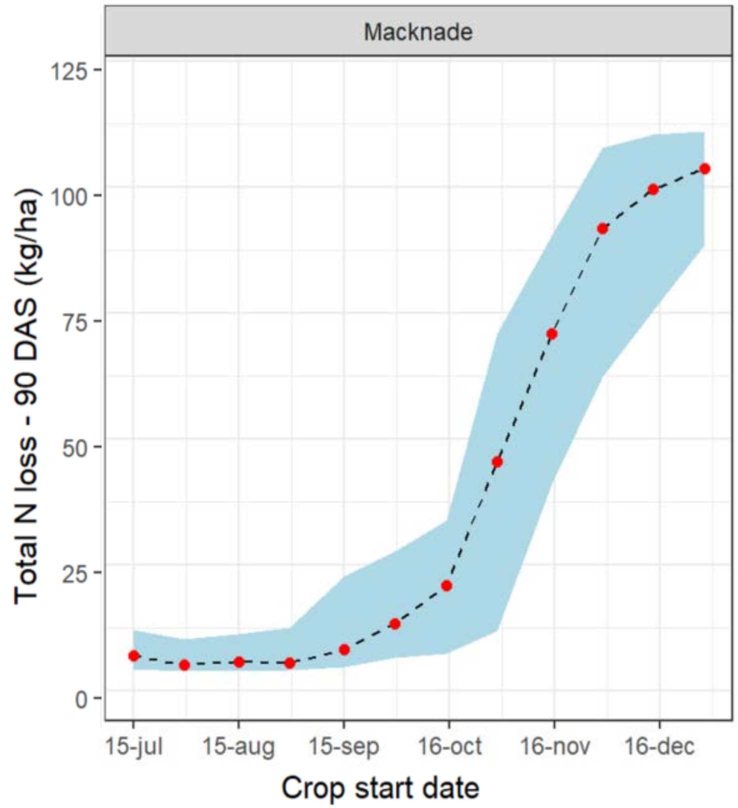
(preliminary results)

Proceedings of the Australian Society of Sugar Cane Technologists, volume 41, 383–393, 2019

Crop timing interactions with time of N loss

Timing onset wet-season





Duration of wet events, other effects on crop growth potential

Verburg et al. (2019) Final Report SRA 2017/015

Changing climate

Bonnett GD — **Proc Aust Soc Sugar Cane Technol Vol 40 2018**

THE WEATHER EXPERIENCED BY SUGARCANE PRODUCTION SYSTEMS IN NORTHERN QUEENSLAND HAS CHANGED OVER THE PAST 80 YEARS

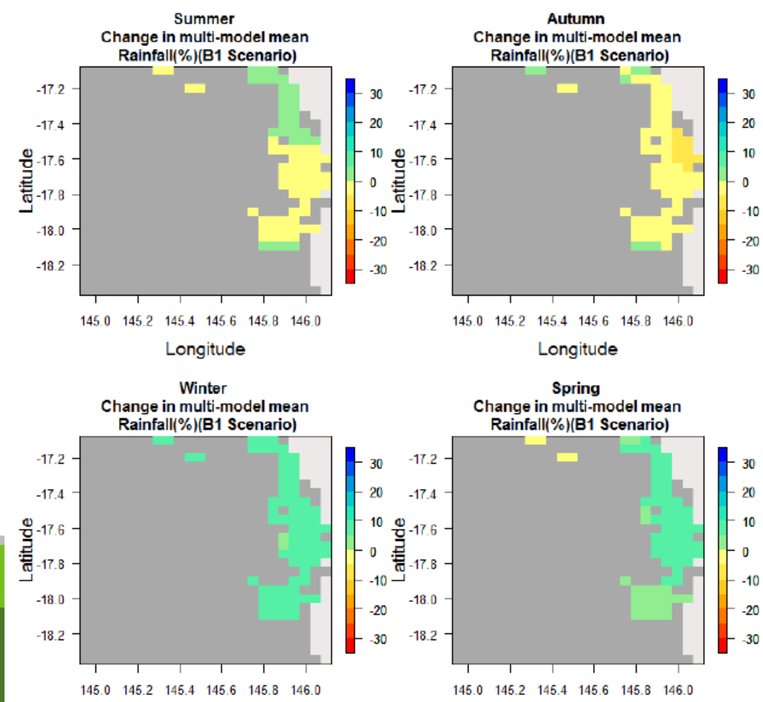
- Northern sugar growing region around Mulgrave Mill (Cairns)
- Increase October rainfall

2012

SRDC Research Project final report

How will climate change impact climate variability in sugarcane growing regions?

Everingham, Y



Conclusion

- Large seasonal variability in N loss, which would be sensitive to changing climate.
- The efficacy of EEFs is complex, site-specific and subject to seasonal climate conditions.
- Given cost of EEF only tactical use of EEF viable?
- Virtual trials allow analysis of the complex interactions with seasonally variable climate conditions.
- They also provide an effective means of communication.

Thank you

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