



THE UNIVERSITY OF
MELBOURNE

FACULTY OF
VETERINARY &
AGRICULTURAL
SCIENCES

Nitrogen decisions for cereal crops: a risky and personal business

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- Dryland (rainfed) wheat production in Australia
 - Look at crop yield responses to N fertiliser
 - Using a crop simulator
 - How important is economics in N decisions?
 - Predictions from an economic model or framework
 - What growers actually do
 - Decision Support Systems?
 - Extension to Myanmar
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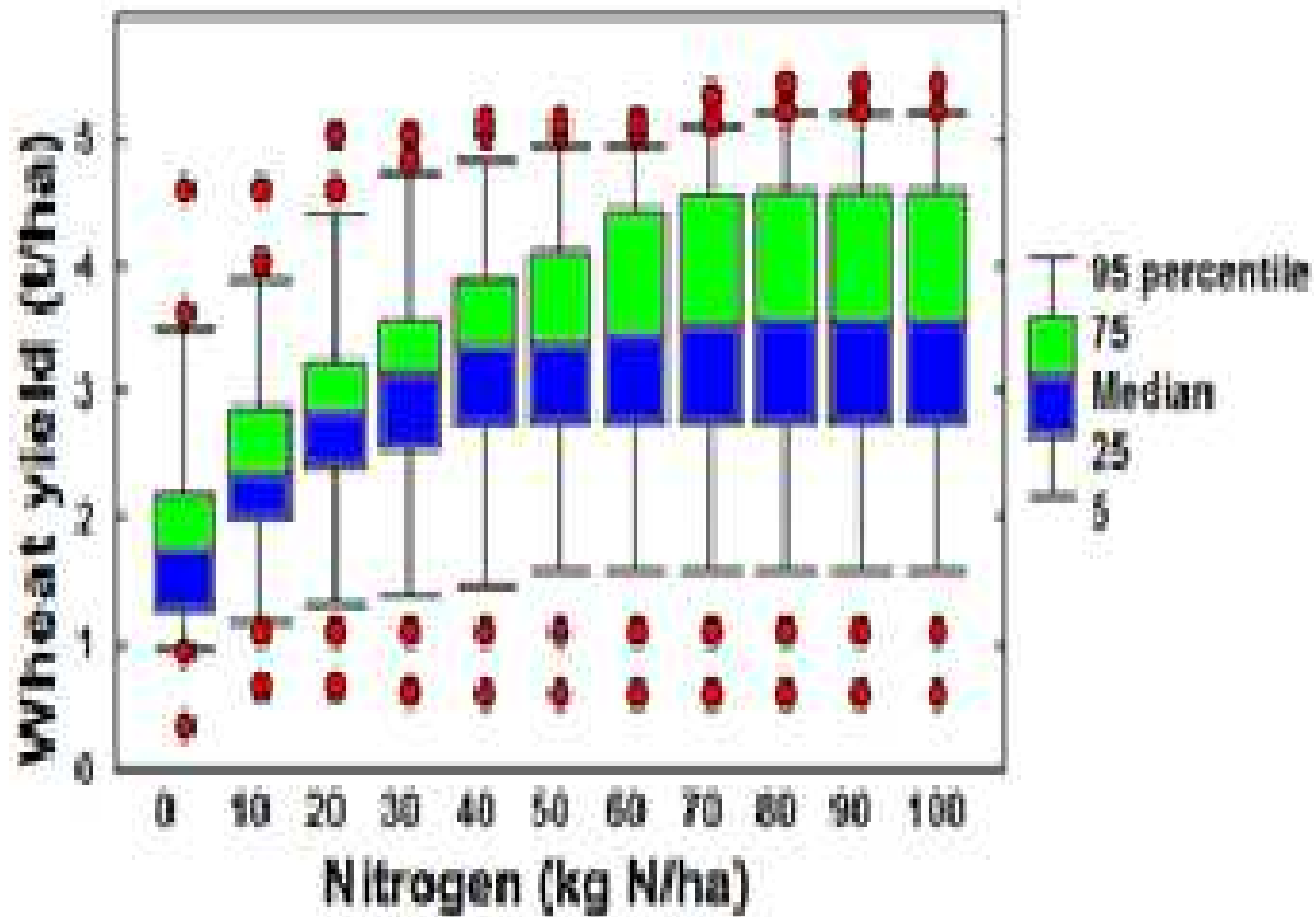
Yield responses

- John Kneipp (Tamworth District Agronomist)
 - ‘To grow wheat you need Nitrogen and water’
 - Hence the WNMM (and APSIM)
 - We expect yields to increase with more N
 - What do these responses look like?
 - A lot of variability in yield response (seasons)
 - Crop simulations at Cunderdin, Rutherglen, Wagga Wagga & Tamworth
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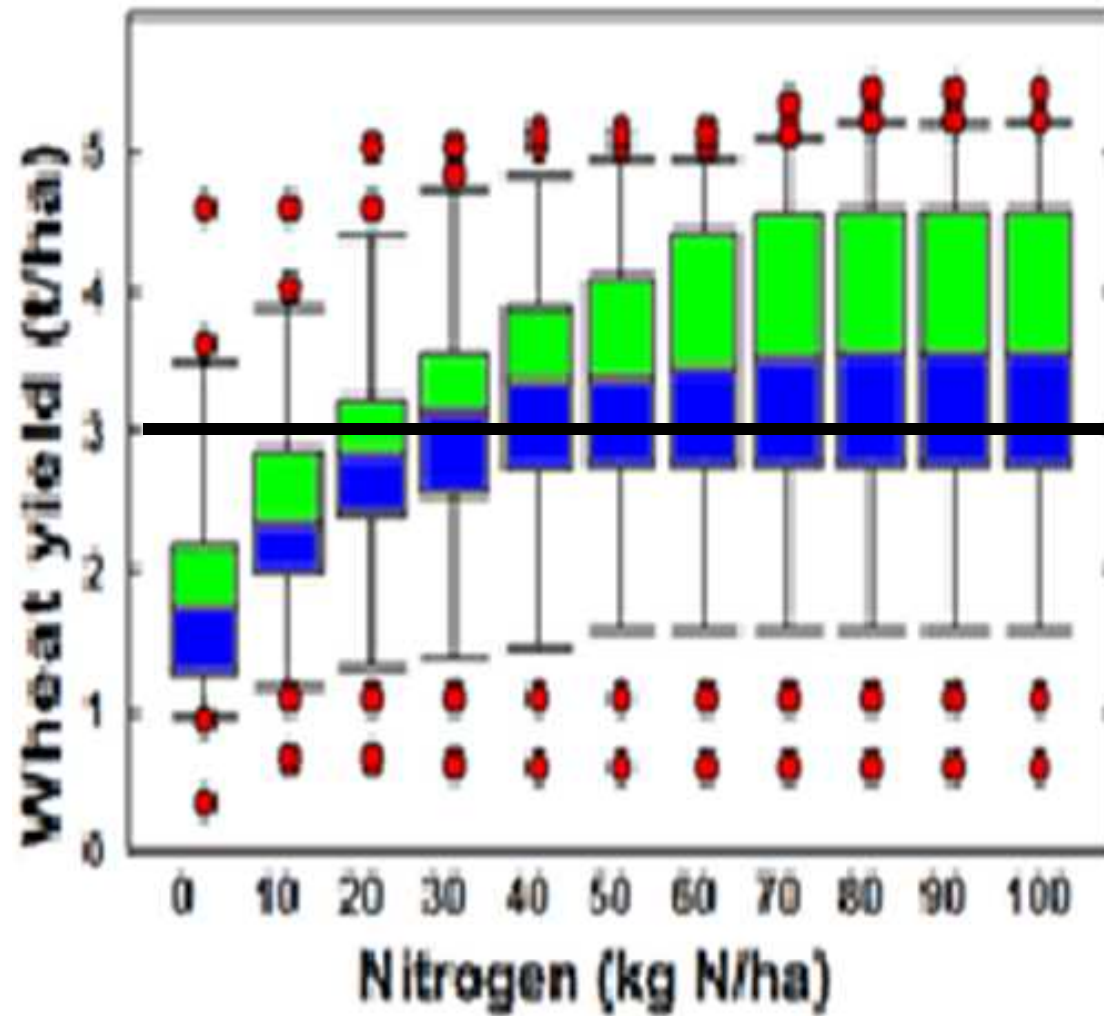
Simulations (Wagga Wagga)

In Wiradjuri language: Wagga Wagga 'place of many crows'





Aside (footprints)





Shape of response

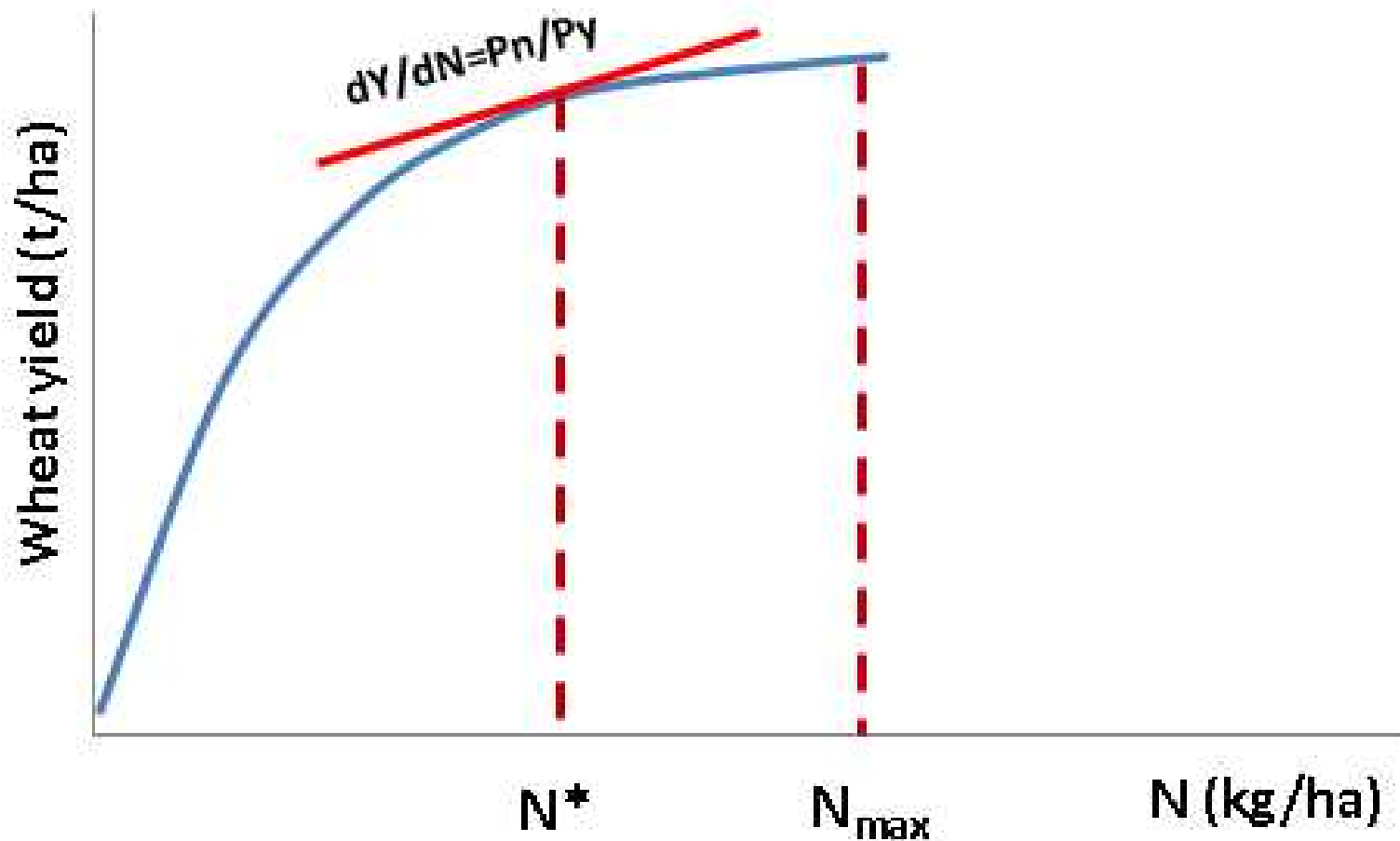
- Diminishing returns responses are common in biology and elsewhere
 - Linear Response and Plateau for individual plants (Law of the Minimum)
 - But concave responses across a field
 - Variation in seed germination and flowering dates
 - Mitscherlich ($Y=a(1-\exp(-b.N))$)
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- 10th, 50th & 90th percentiles of yield distributions, to represent
 - ‘Poor’, ‘Medium’ and ‘Good’ seasons
 - We fitted Mitscherlich functions
 - How do these percentiles move?
 - Just up and down (North-South) or also across (East-West)?
 - This might affect the N use decision
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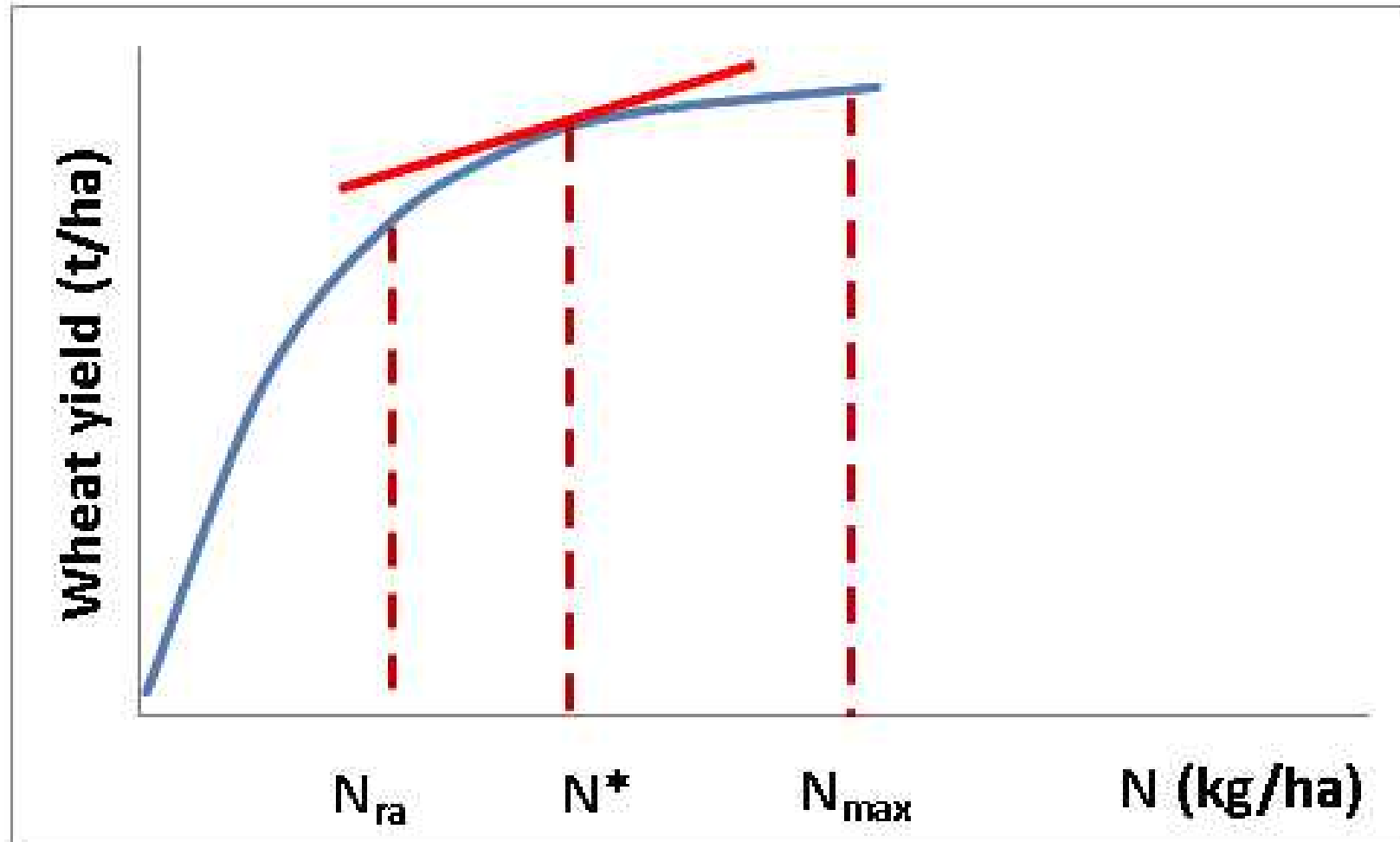


Production economics framework



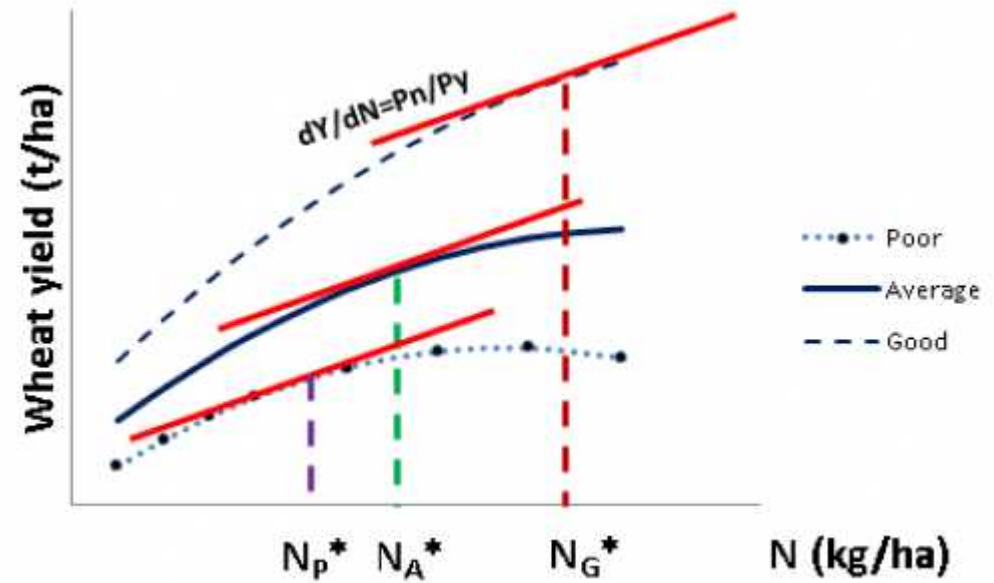
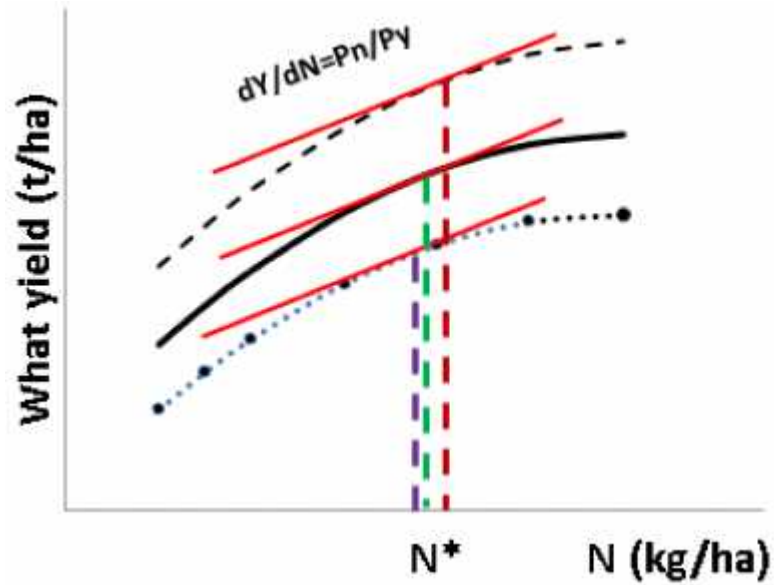


Risk aversion and N decisions



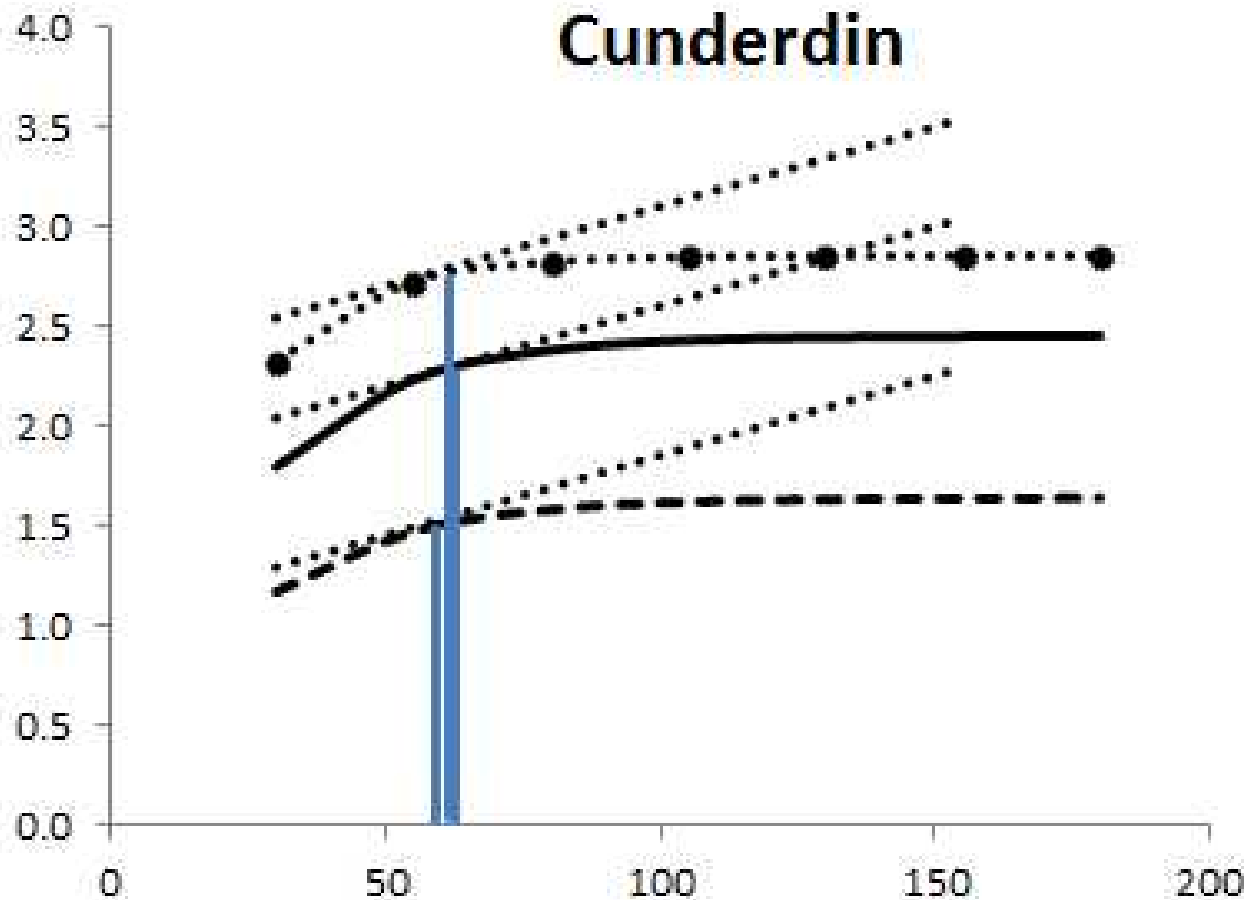


Economic model predictions





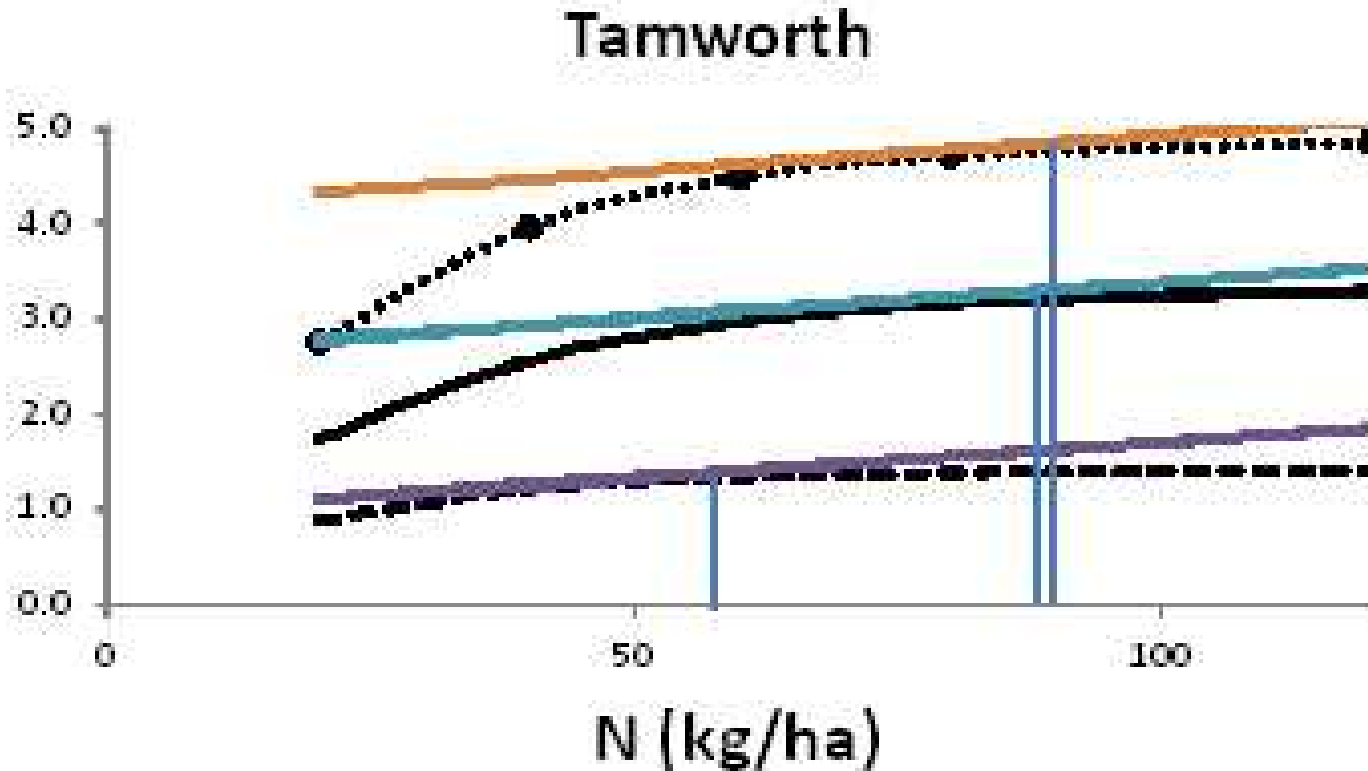
Cunderdin results



North-South movement, little change in decision between season type



Tamworth results



North-South and East-West, N decision varies with season

- We asked agronomists at each location about typical grower decisions
 - Grower decisions at or below the economic rates
 - But growers seem to have the yield responses and prices in mind
 - Economic framework is 'roughly right'
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Predicted & Actual decisions

Location	Theoretical economic N rates			Typical grower decisions	MRR for 'Medium' 100% ROI
	Season type				
	'Poor' (10 th)	'Medium' (50 th)	'Good' (90 th)		
	Kg N/ha	Kg N/ha	Kg N/ha	Kg N/ha	Kg N/ha
Cunderdin	67	74	65	20 – 50	55
Rutherglen	53	64	62	18 - 109	50
Wagga Wagga	54	54	79	37/46 + 28/37	40
Tamworth	52	85	87	80 (split)	60



Add risk aversion

- Growers may be averse to (prefer to avoid) the chance of bad outcomes
 - If so they may be cautious in their decisions
 - Avoid spending extra money with a greater chance of failure
 - Risk aversion is a friction to decision making
 - N decisions are also personal decisions
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- *‘Cereal growers and agricultural consultants in Australia do not seem to use a formal N optimising economic framework when advising clients’*
 - Dr. Rob Norton, International Plant Nutrition Institute
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Conclusion

- The shape and variability in crop yield responses to N make using an economic framework for precise N recommendations an '*absurdity*', (Jock Anderson 1975)
- N decisions are risky and growers make their own personal (or subjective) decisions
- But the economic framework is 'roughly right'
 - The yield max N rate is too high
 - Best N rates vary between Good and Poor seasons at some locations (soil types)
 - Adding risk aversion reduces the rates further



In Myanmar

- Myanmar farmers (smallholderds) are
 - Poor, indebted, risk averse, less educated, and have high borrowing rates
 - Add an extra requirement for a 100% Return on Investment (ROI) in developing fertiliser recommendations (CIMMYT 1988)
 - They will resist us recommending a big investment in fertiliser to increase yield if the higher potential yield comes with a higher risk of bad outcomes
 - **We don't decide what is optimum for them**
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