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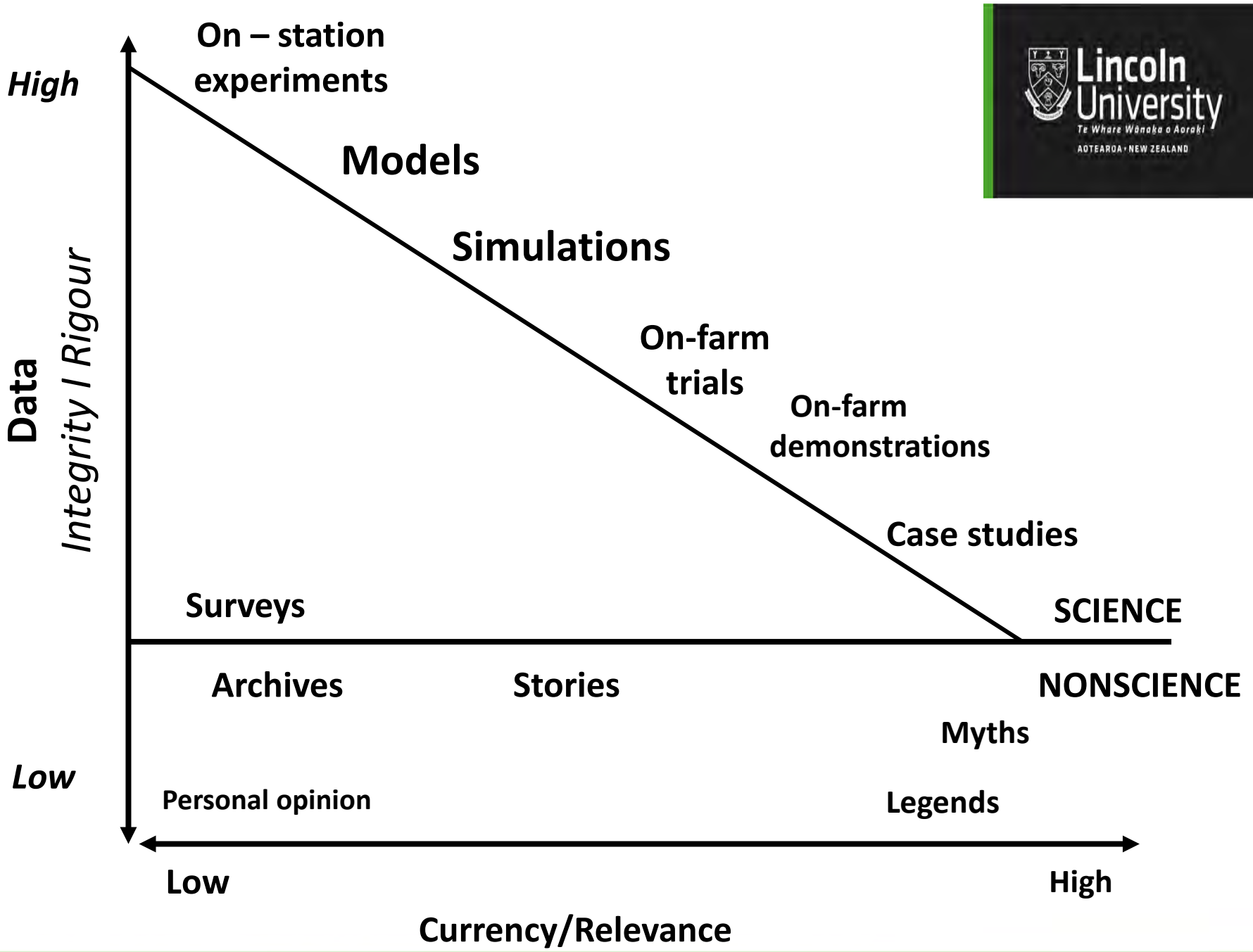
Legumes Regenerate Pastures

Derrick Moot

New Zealand's specialist land-based university



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Bonoma 1985

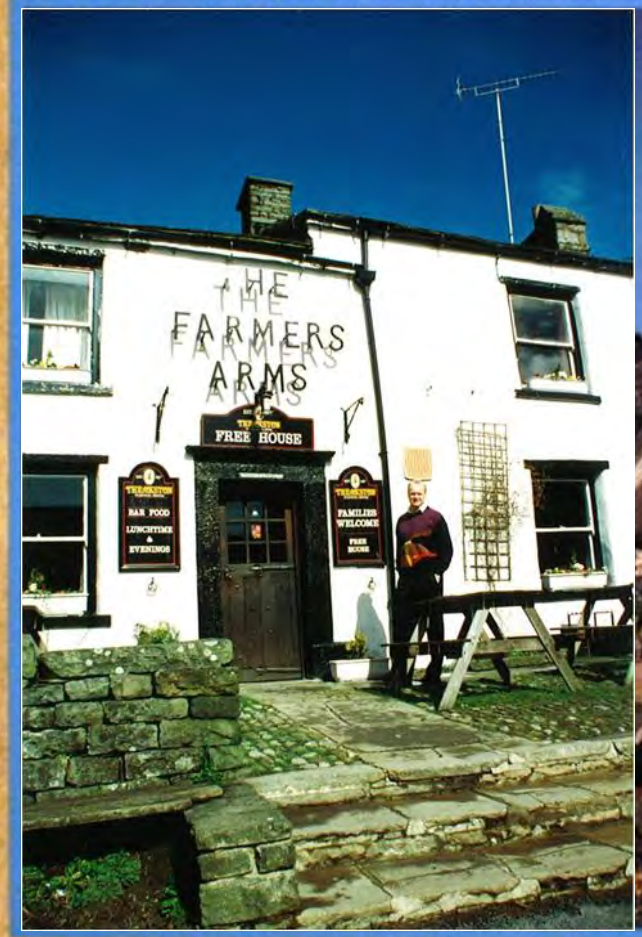
PLSC 401 AGRONOMY 1986

Back Row: Graeme BASSETT, Justin de la ROCHE, Peter MOYNIHAN, Ivan LINES, George STEVEN, Kathy NICHOLSON, Nigel UDY, Gaya PRASAD.

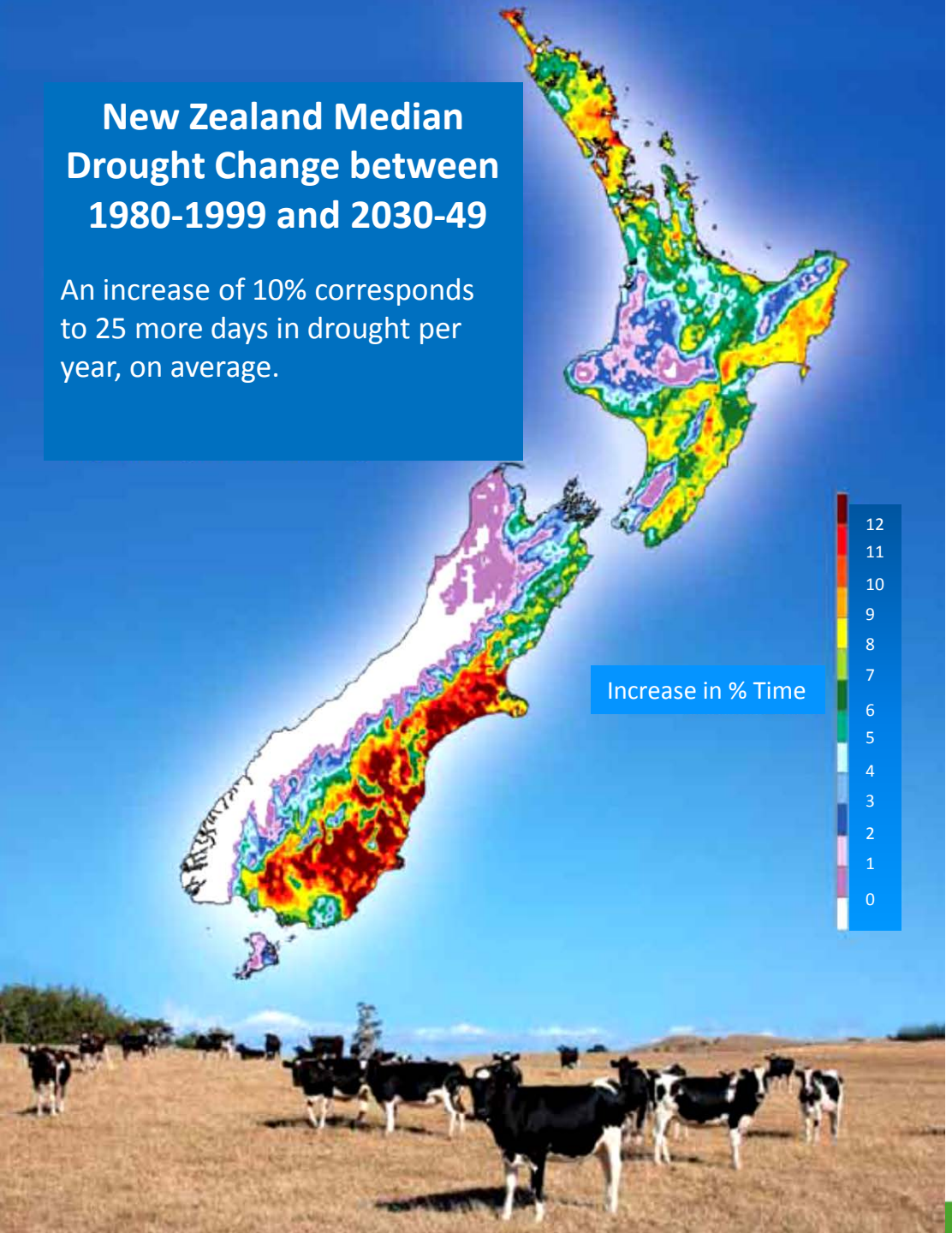
Front Row: Derrick MOOT, Roger BANFIELD, Malcolm MURRAY, John McCOY, Ann BOWEN, Andrew McKAY, Bruce McKAY.

Absent: Helen CAMERON, Ian TATE.

The Village Pub



Roger Protz *and* Homer Sykes



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Predicted climate change in New Zealand by 2040

MPI-NIWA-Drought-in-a-Changing-Climate%20.pdf
http://www.mpi.govt.nz/document-vault/133

Agricultural Science

- Background science – NTW
- Dryland case study – lucerne
- Hill country – annual clovers
- High country – lupins and Caucasian clover
- Lessons for summer safe pastures?

Experiment site

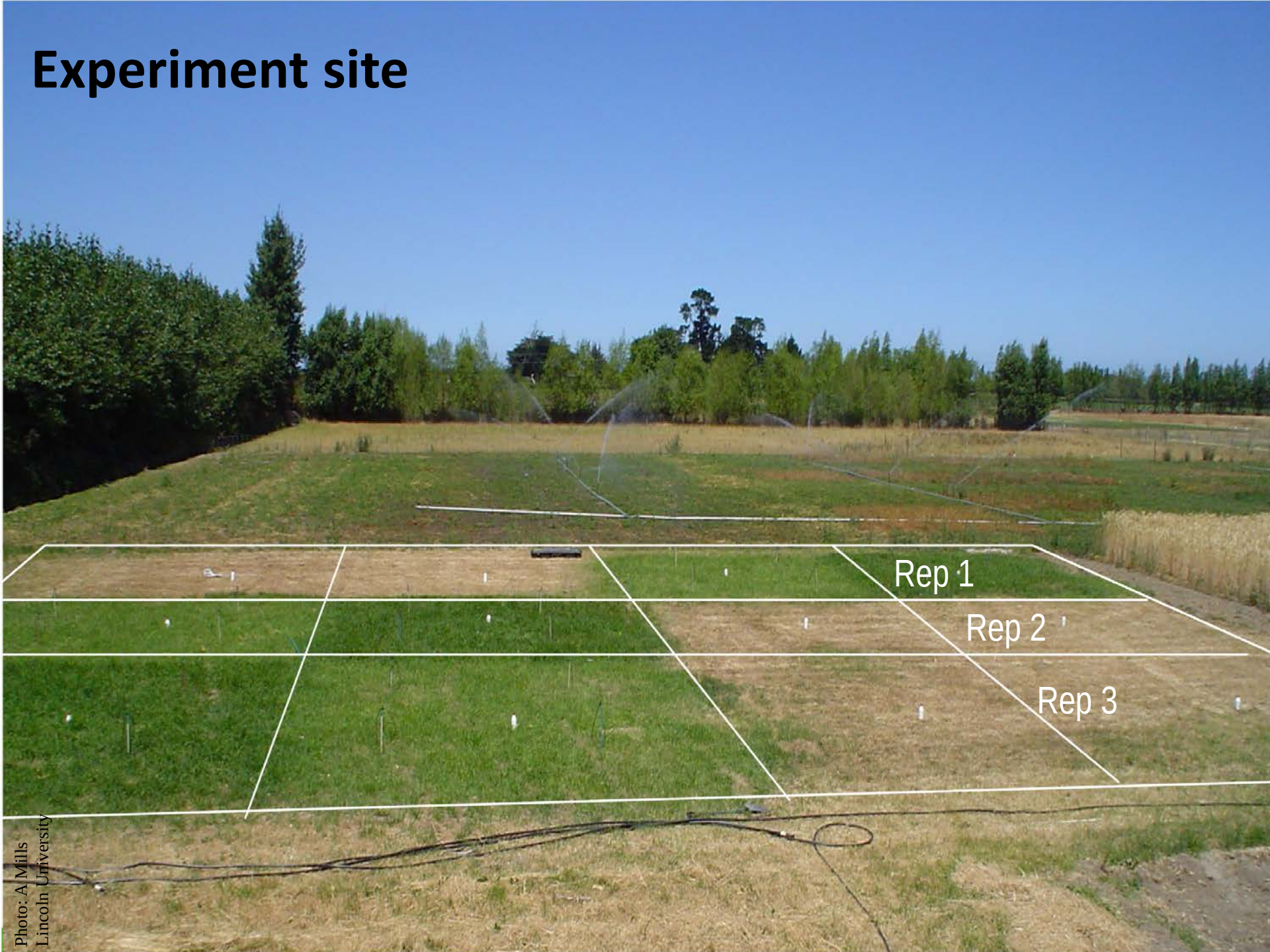
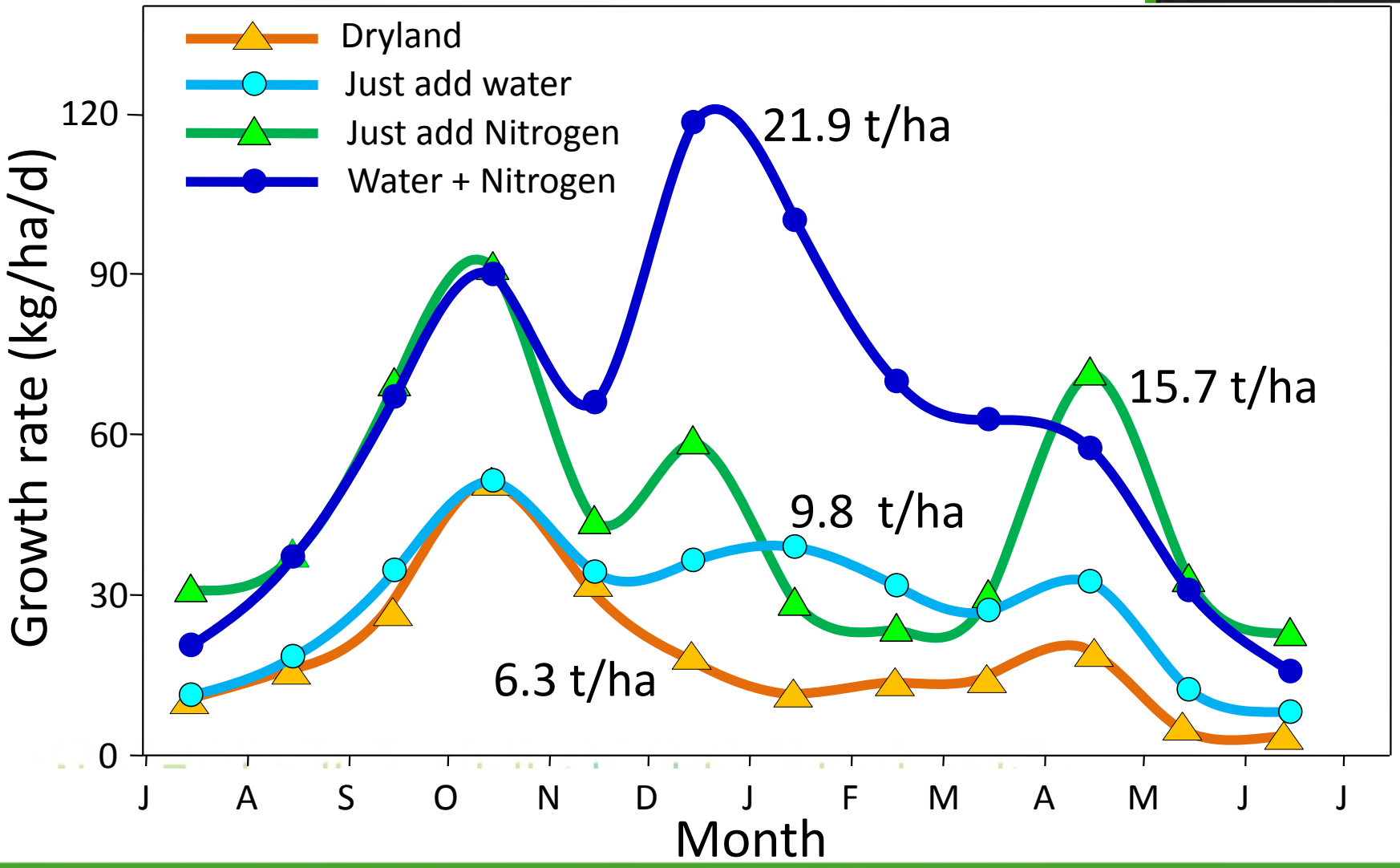


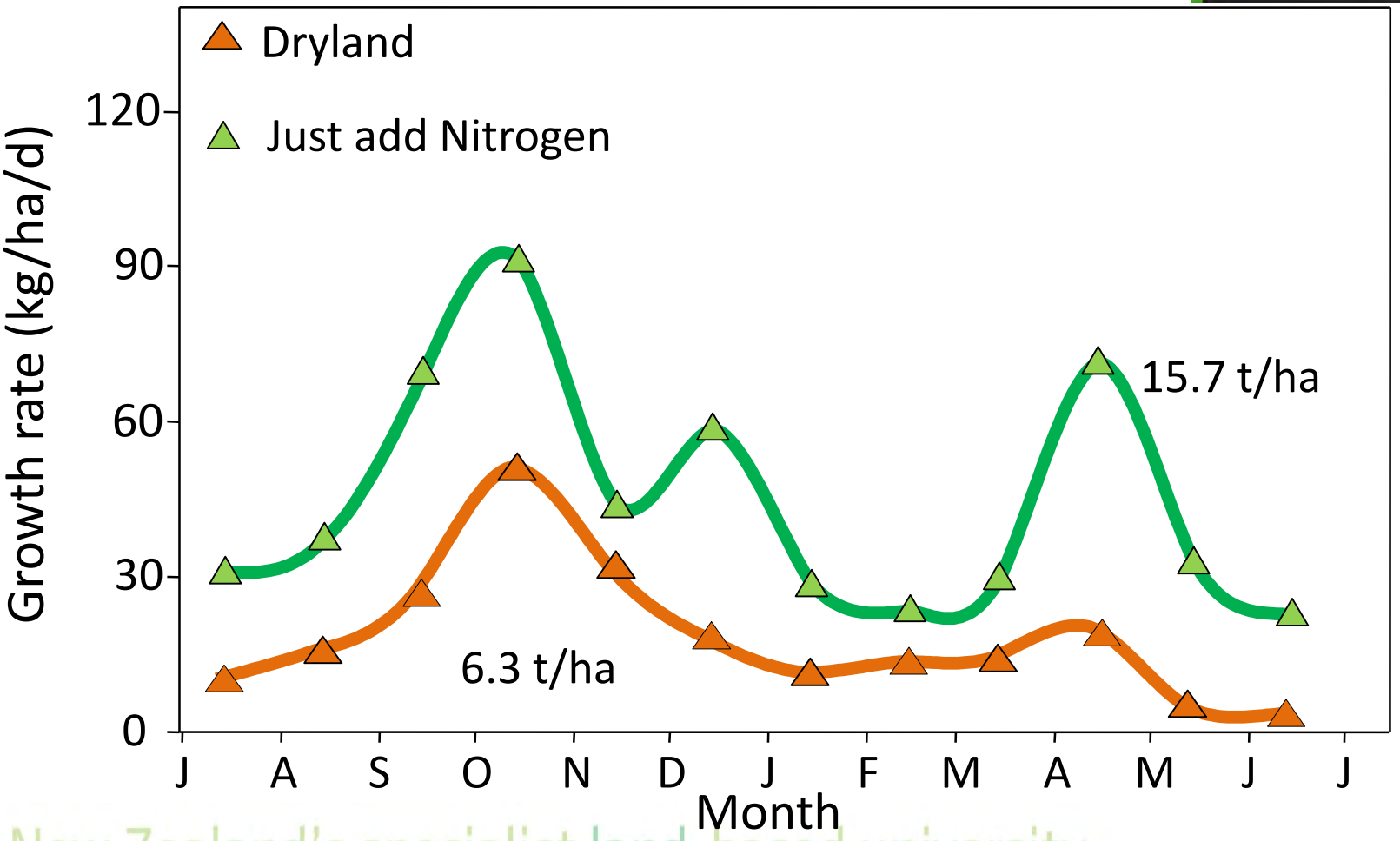
Photo: A Mills
Lincoln University

Growth rates (2 year means)



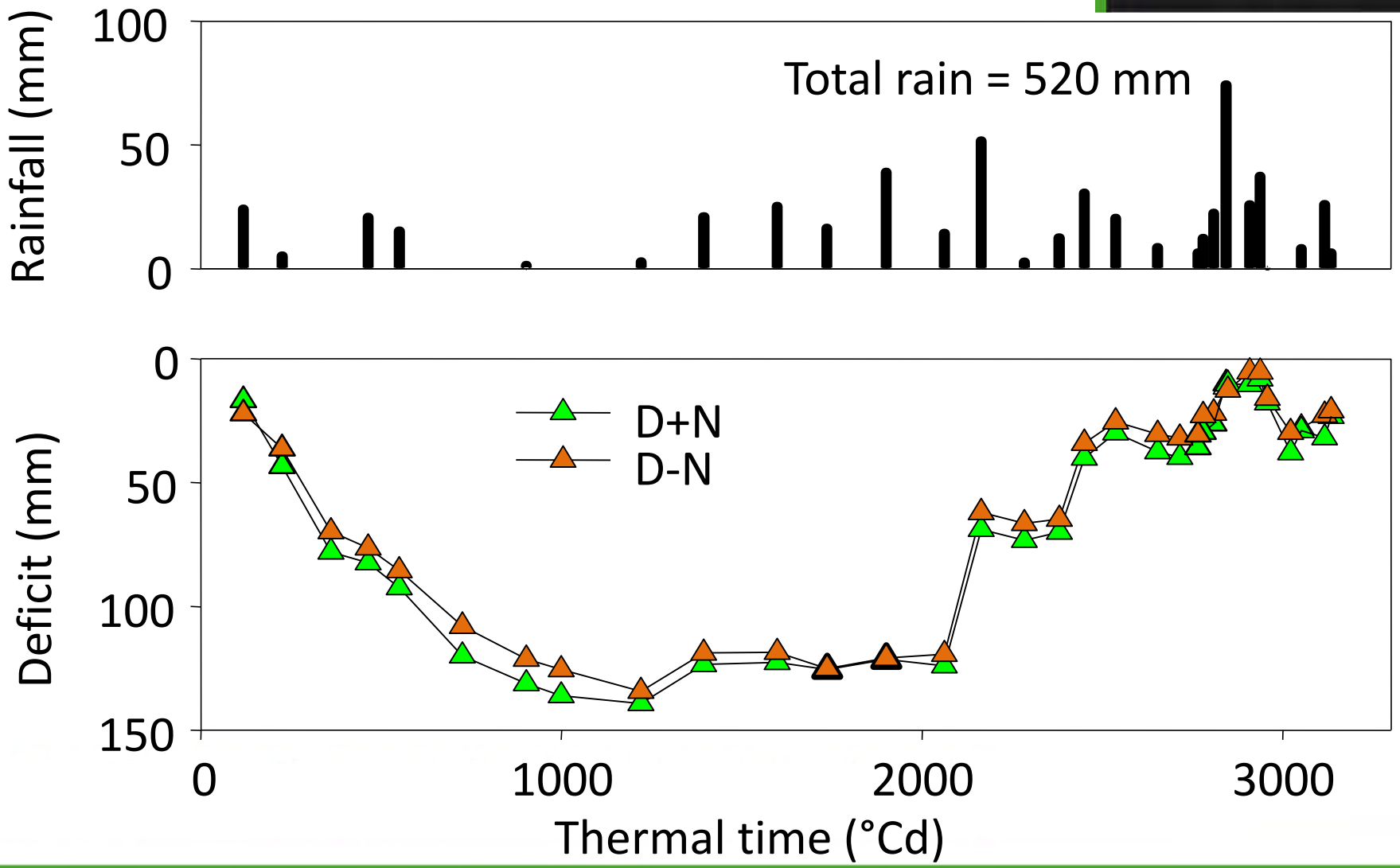
Mills *et al*. 2006, 2009

Growth rates (2 year means)



Mills *et al*. 2006, 2009

Soil moisture deficit 2003/04



Mills 2007

Photo: DJ Moot
Lincoln University

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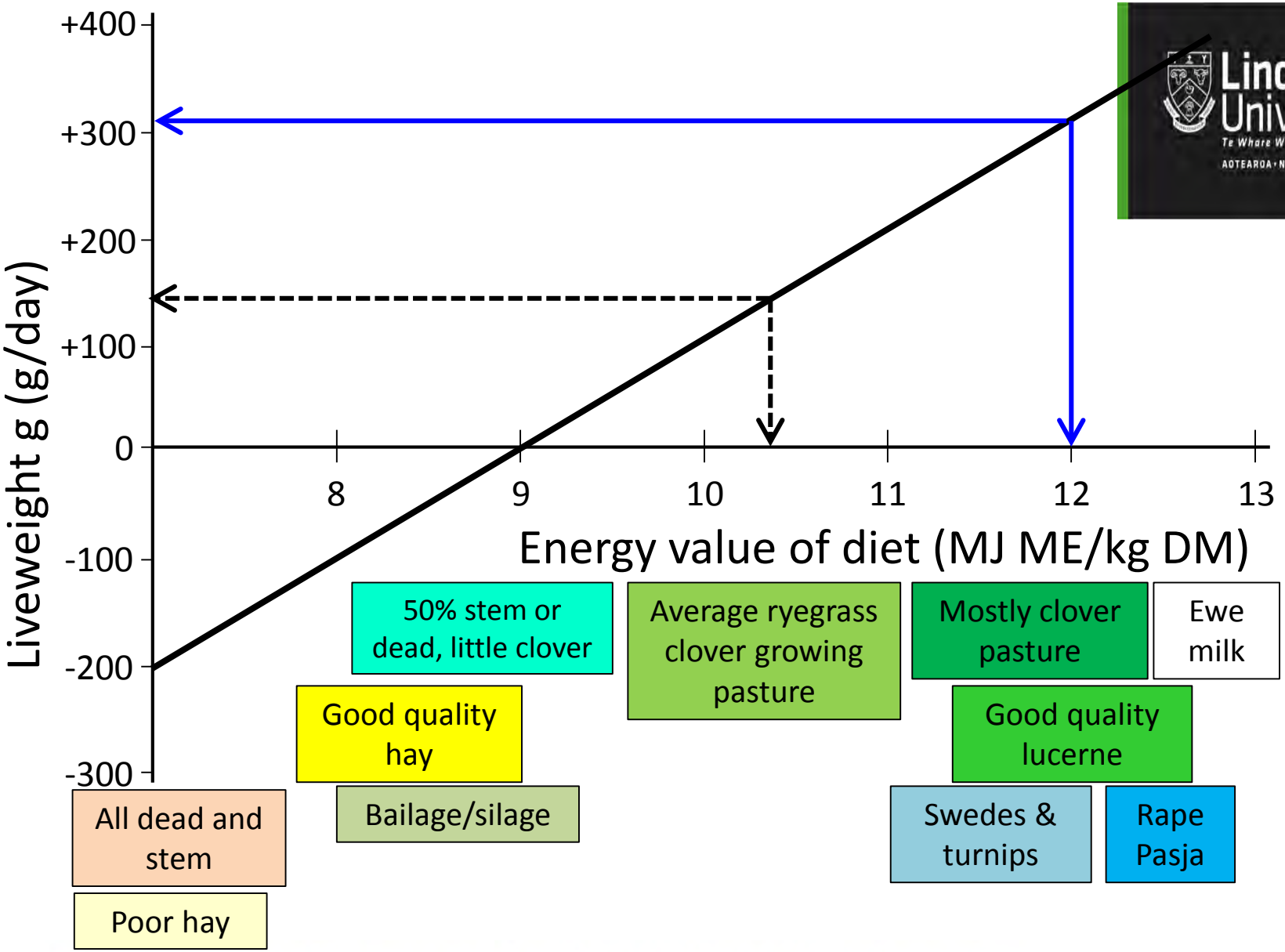
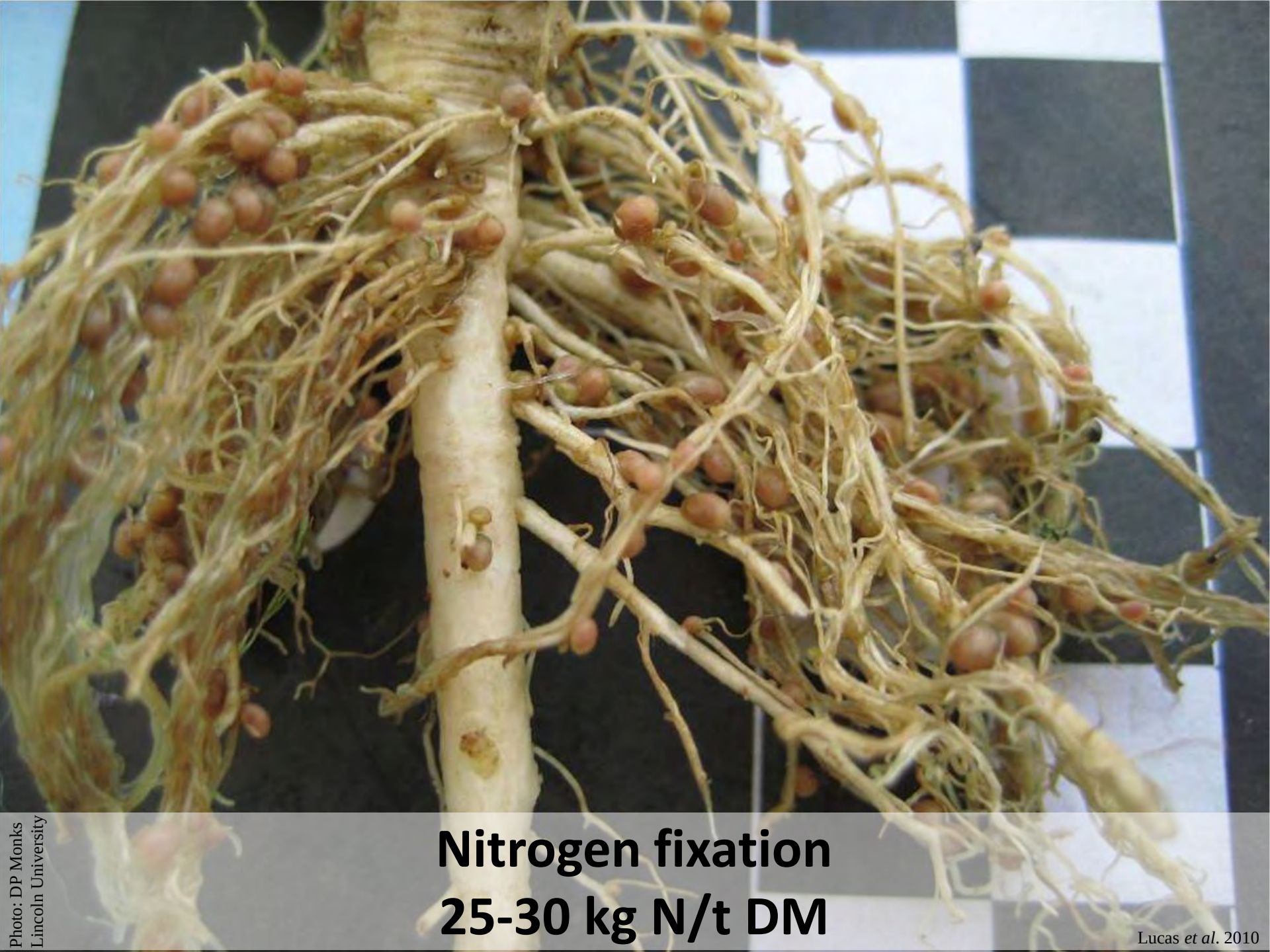




Nitrogen fixation
25-30 kg N/t DM

Photo: DP Monks
Lincoln University

Lucas *et al*. 2010

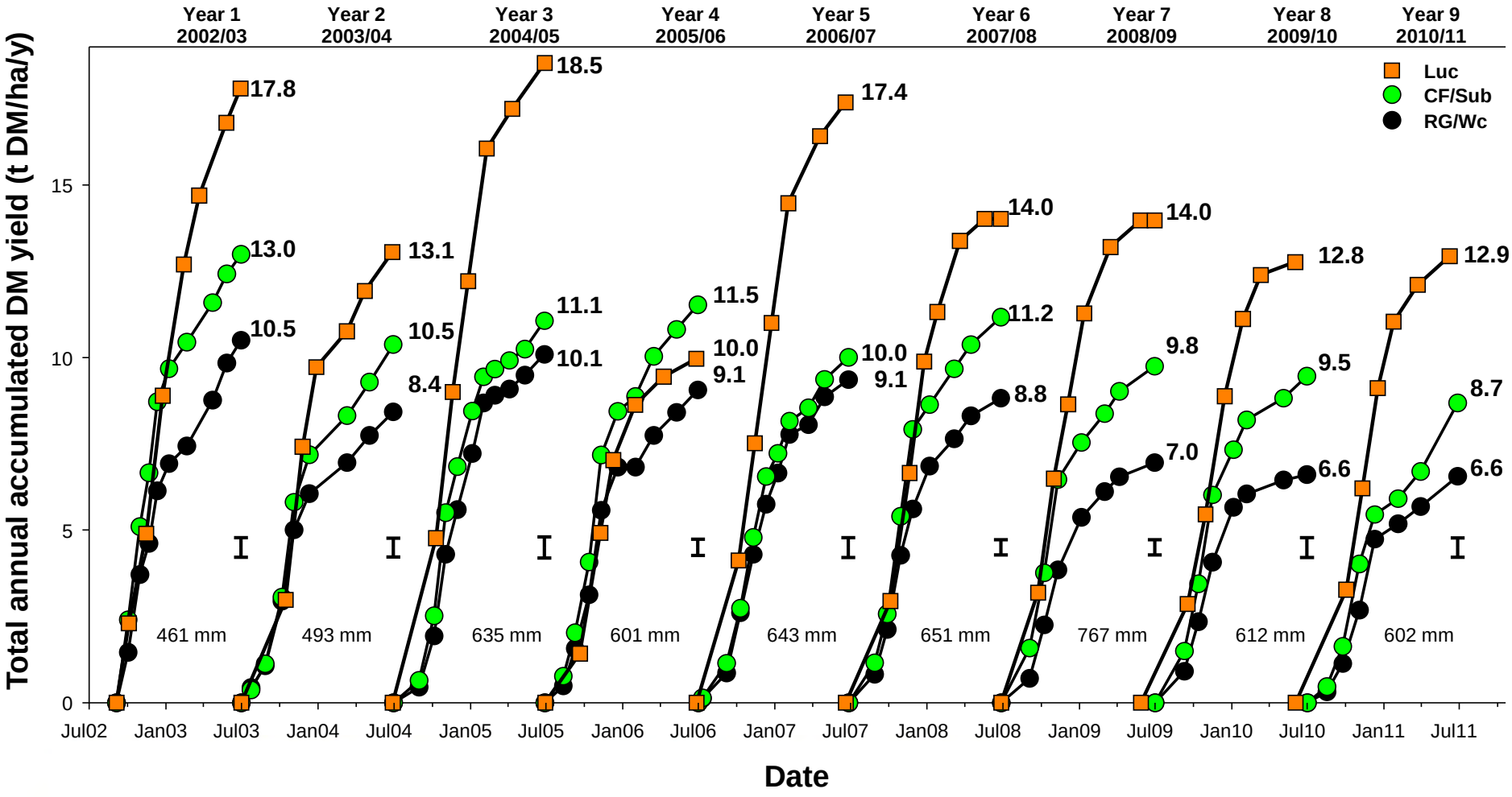
Dryland pastures

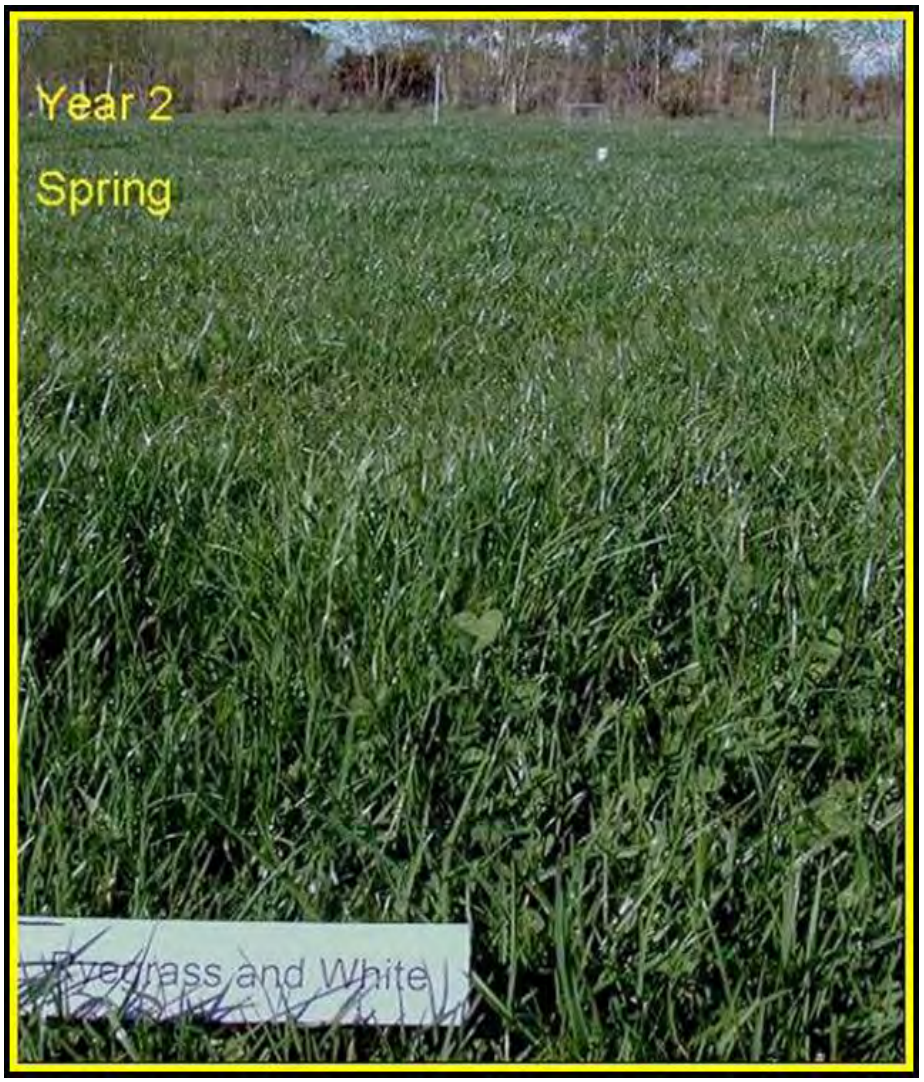
- Soil water recharge most springs
- Low N fertilizer use
- High spring feed demand – breeding systems
- Adaptable to climate variability – future scenarios
- Sustainable – financially, socially, environmentally
- Highly variable summer/autumn rainfall

"Legume based designer swards"

‘ Grazing Expt. - MaxClover’

MaxClover Total DM yields



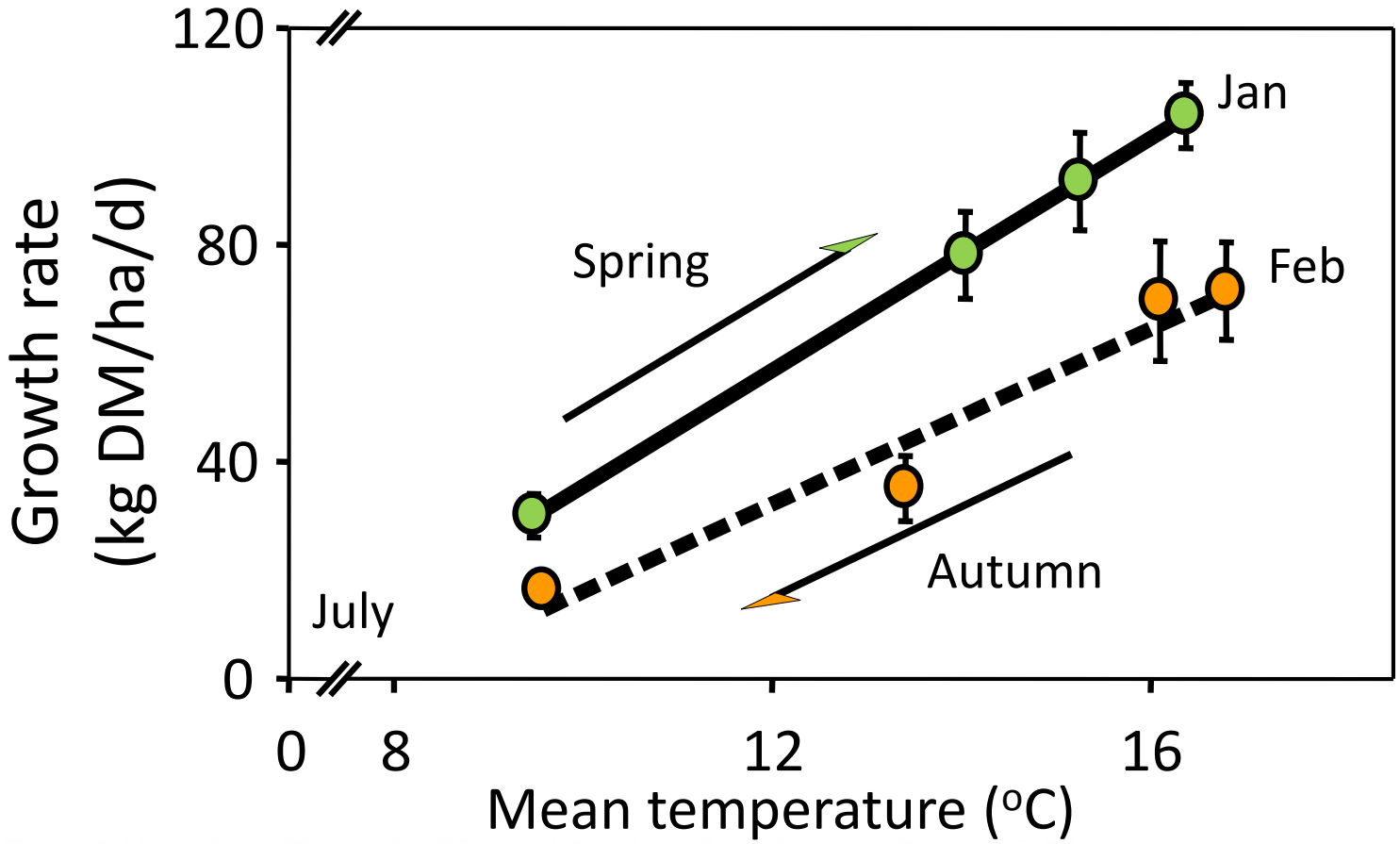


Unsown species <5% in Year 1 …….>45% in Year 6

RG/Wc pastures

The canopy:
the energy capture device

Vegetative growth



Moot *et al*. 2003

Experiment 2 flexible grazing

38 days resting

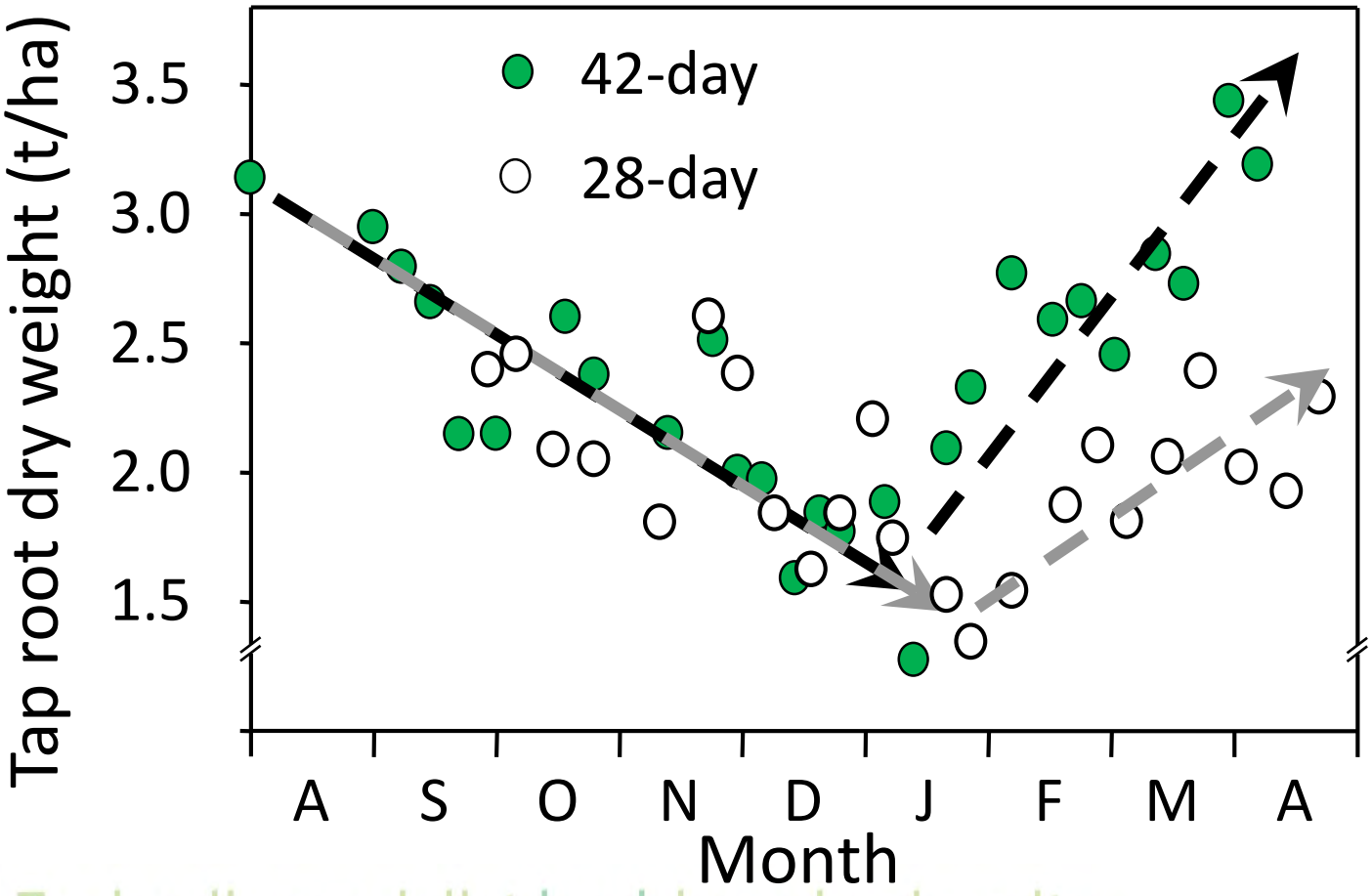
4 days grazing

25 days resting

3 days grazing

Photo: E.I. Teixeira
Lincoln University

Partitioning to roots



Moot *et al*. 2003

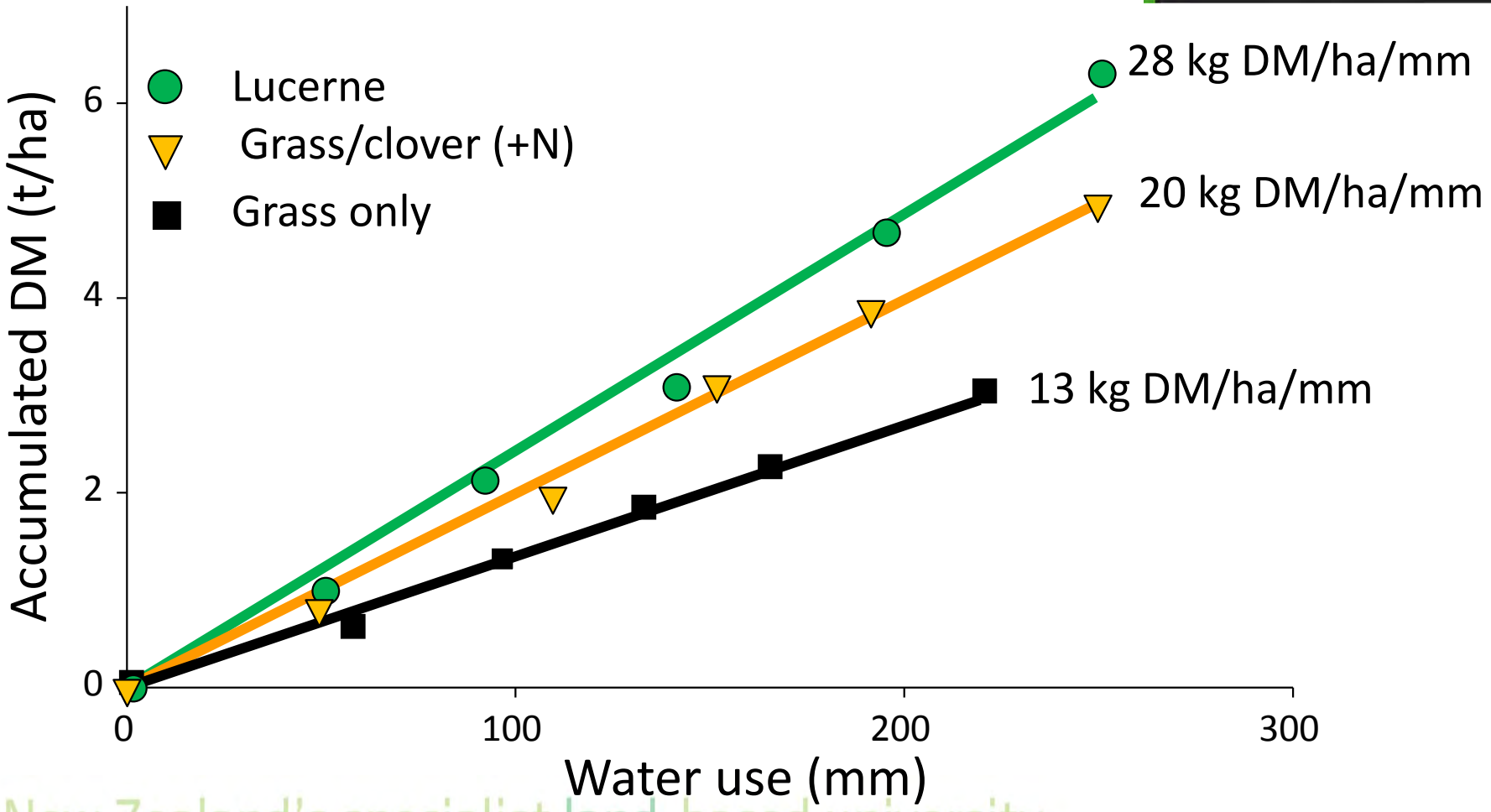
Case study – Bonavaree farm, Marlborough

Over grazed – high erosion risk

Financially – no return

Dryland lucerne conversion

Spring WUE



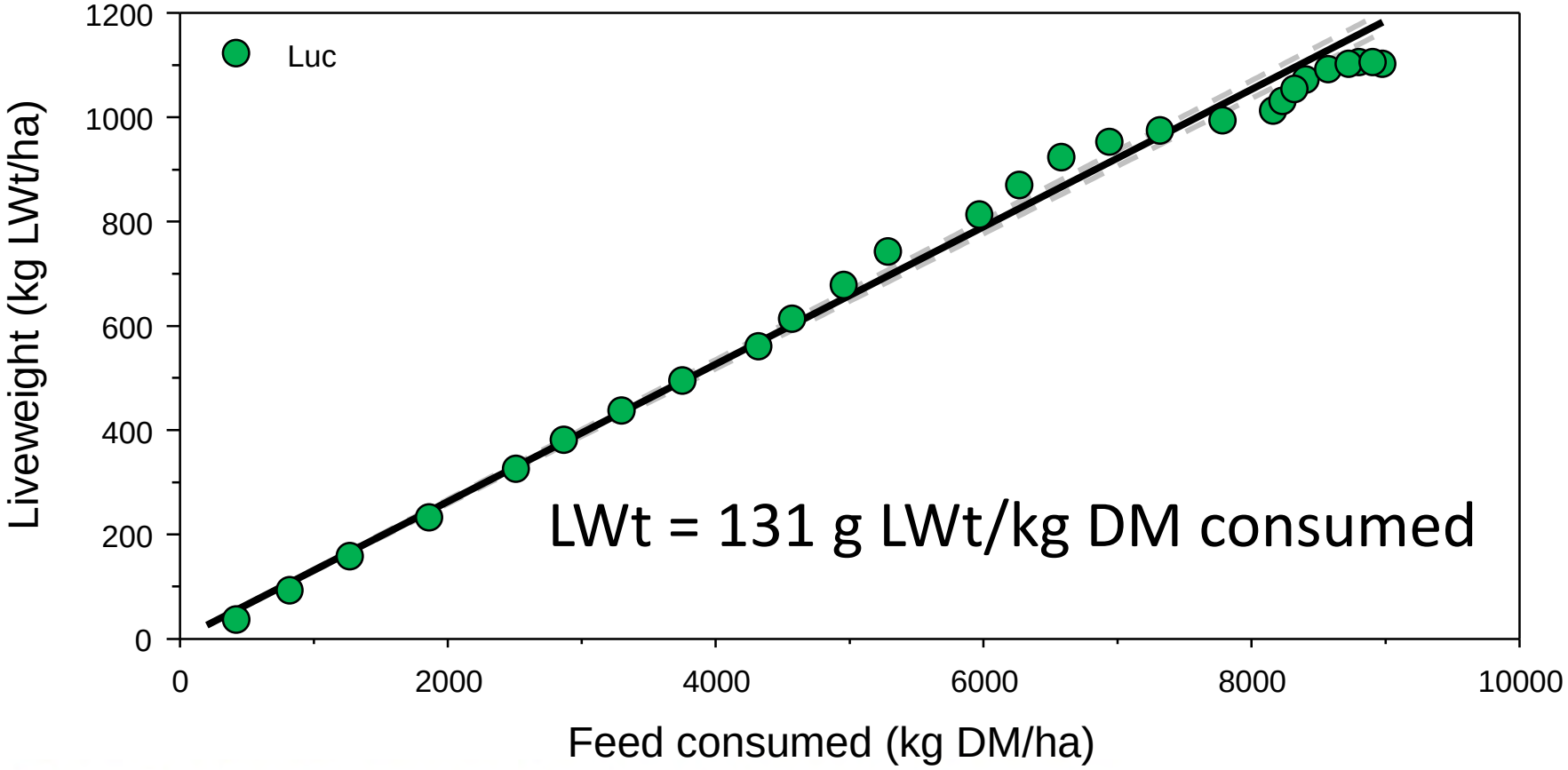
Moot *et al*. 2008

Bonavaree 14/8/2017

Photo: DJ Moot
Lincoln University

Photo: Doug Avery, Bonavaree

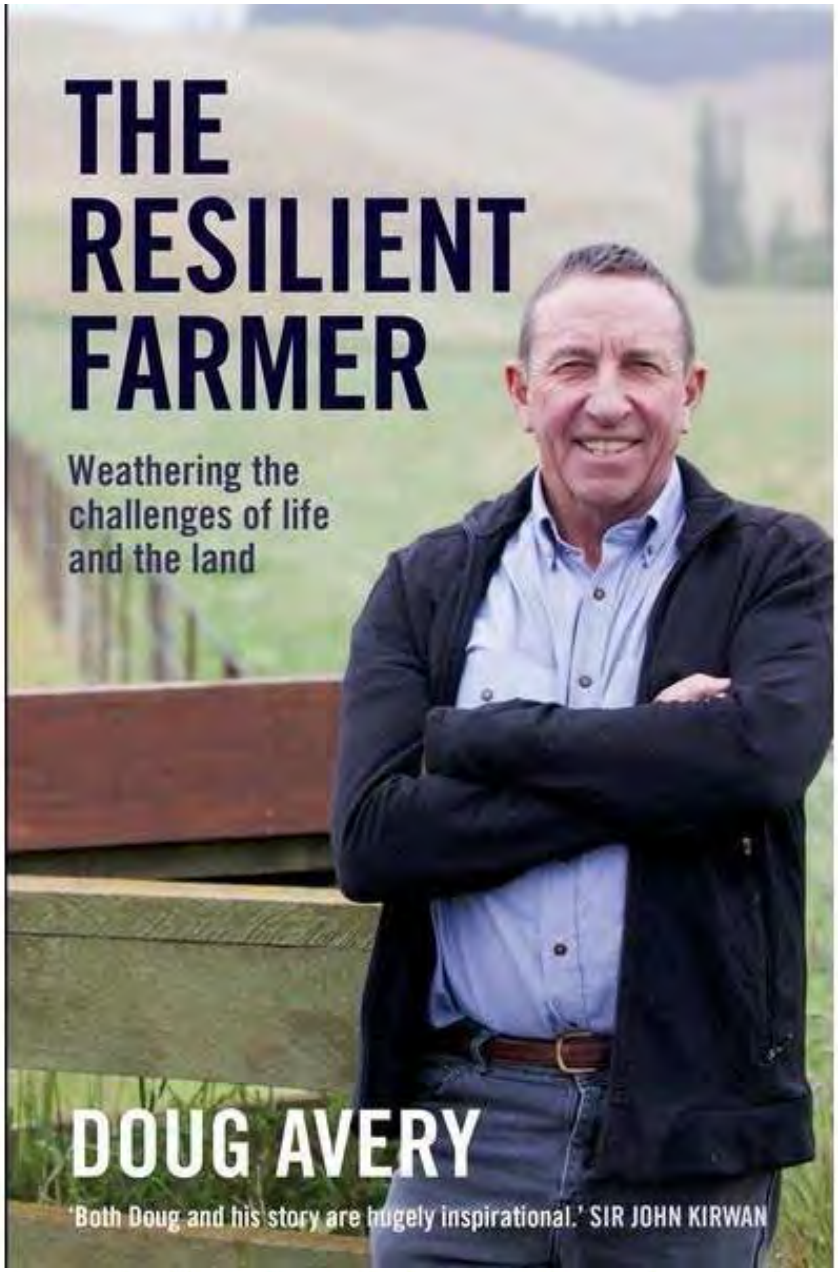
Relationship between LWt production and feed consumed



T Ryan-Salter unpublished

‘Bonavaree’ production change over 10 years

	2002	2012	Change
Land area (ha)	1100	1800	↑ 64%
Sheep numbers	3724	4158	↑ 12%
Lambing (%)	117	145	↑ 28%
Lamb weights (kg)	13.3	19	↑ 43%
Lamb sold (kg)	38324	74460	↑ 94%
Wool (kg)	18317	20869	↑ 14%
Sheep:cattle	70:30	50:50	
Gross trading profit (ha)	$317	$792	↑ 149%



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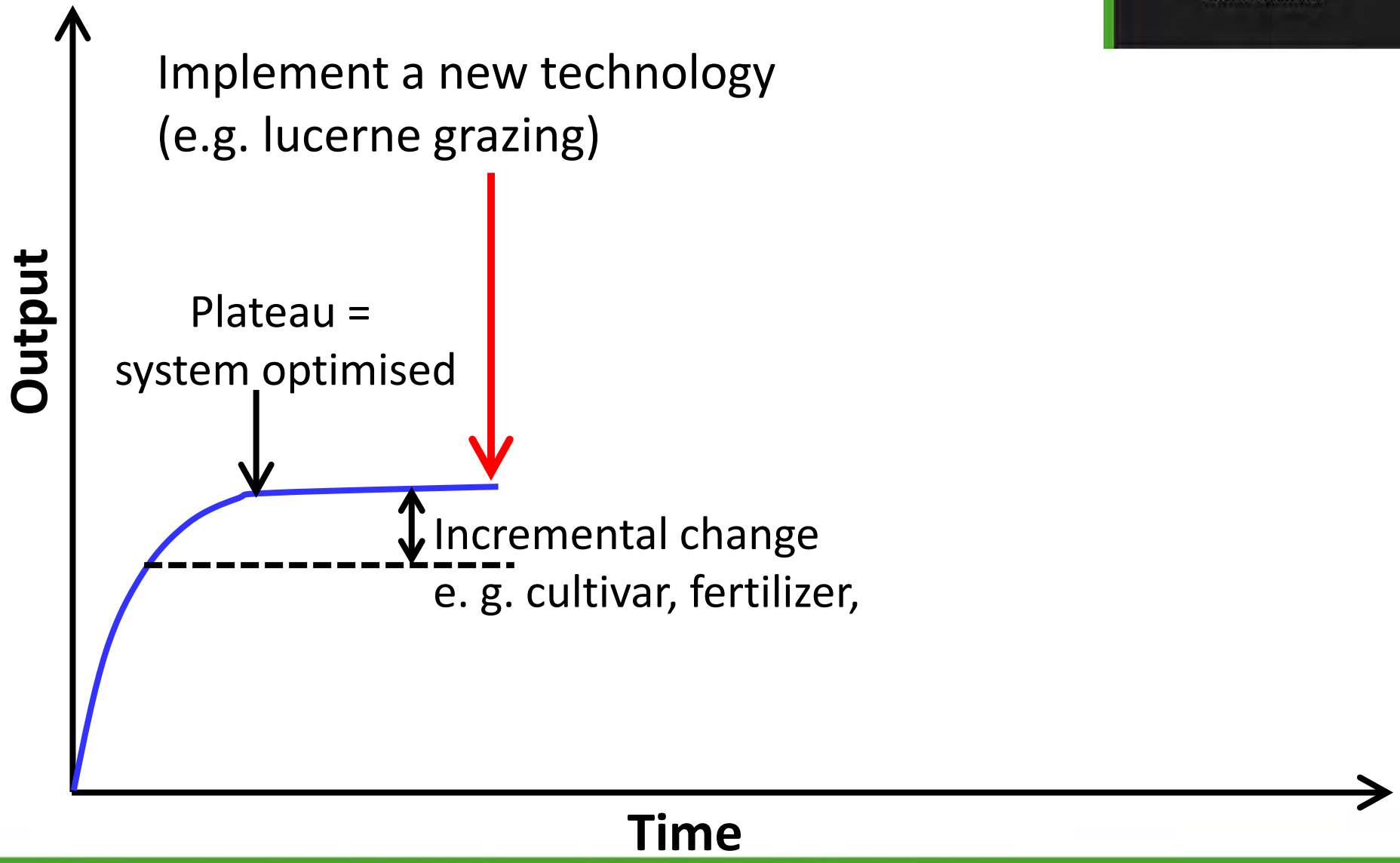
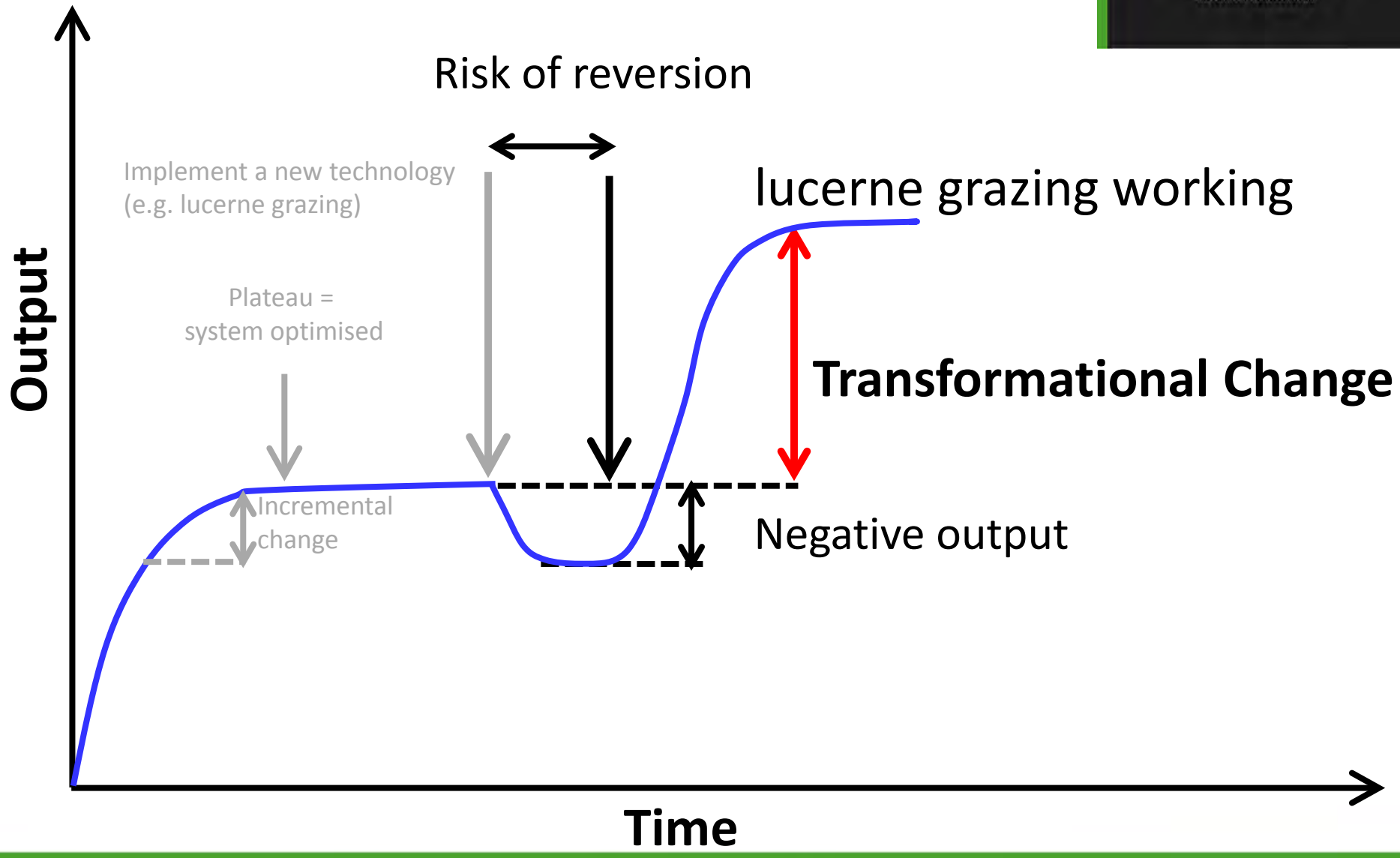
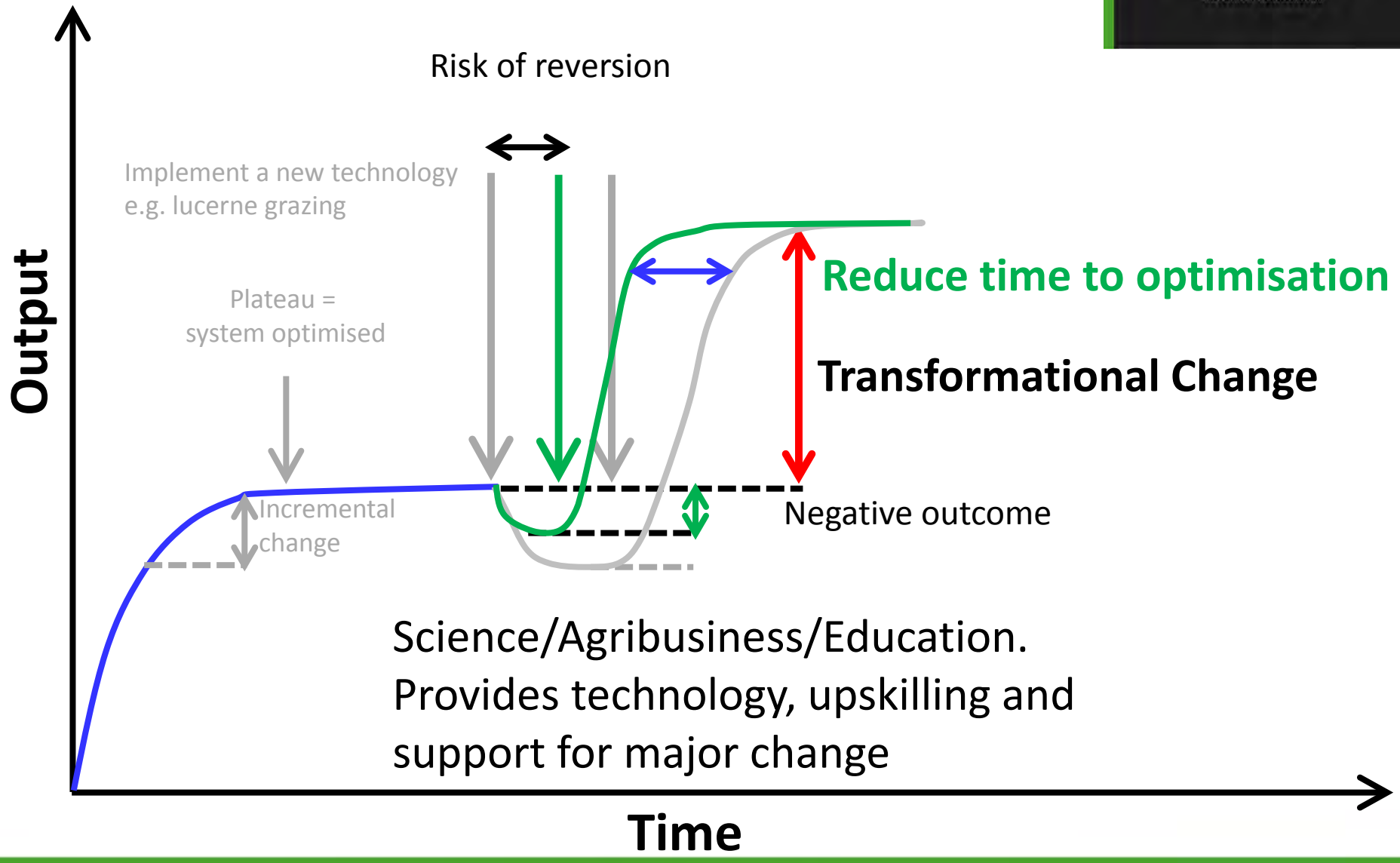
Pathway to change



Pathway of change

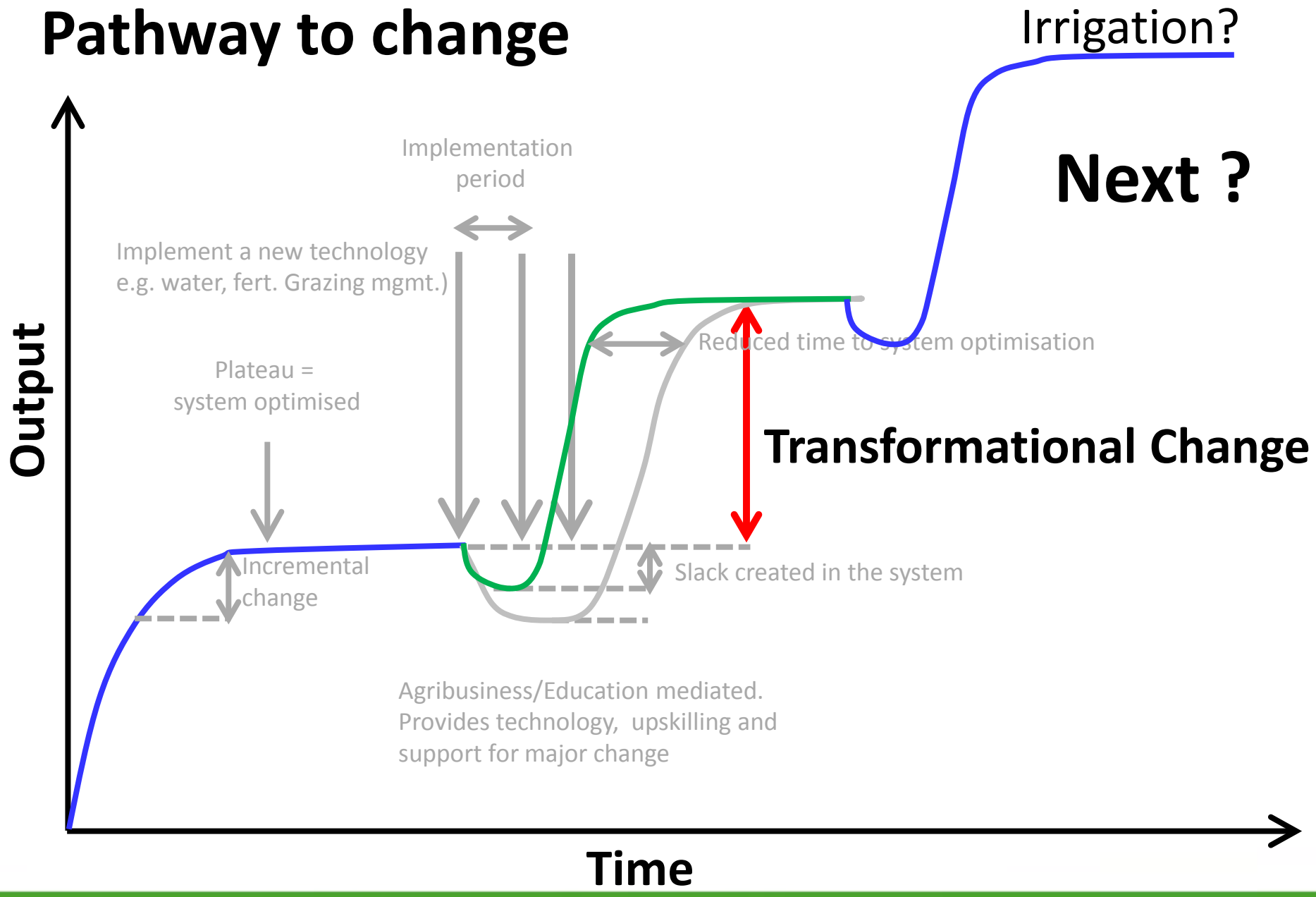


Pathway to change



Science/Agribusiness/Education.
Provides technology, upskilling and support for major change

Pathway to change



Landscape farming – Bog Roy Station

Photo DJ Woot
Lincoln University

Photo: Derrick Moot
Lincoln University

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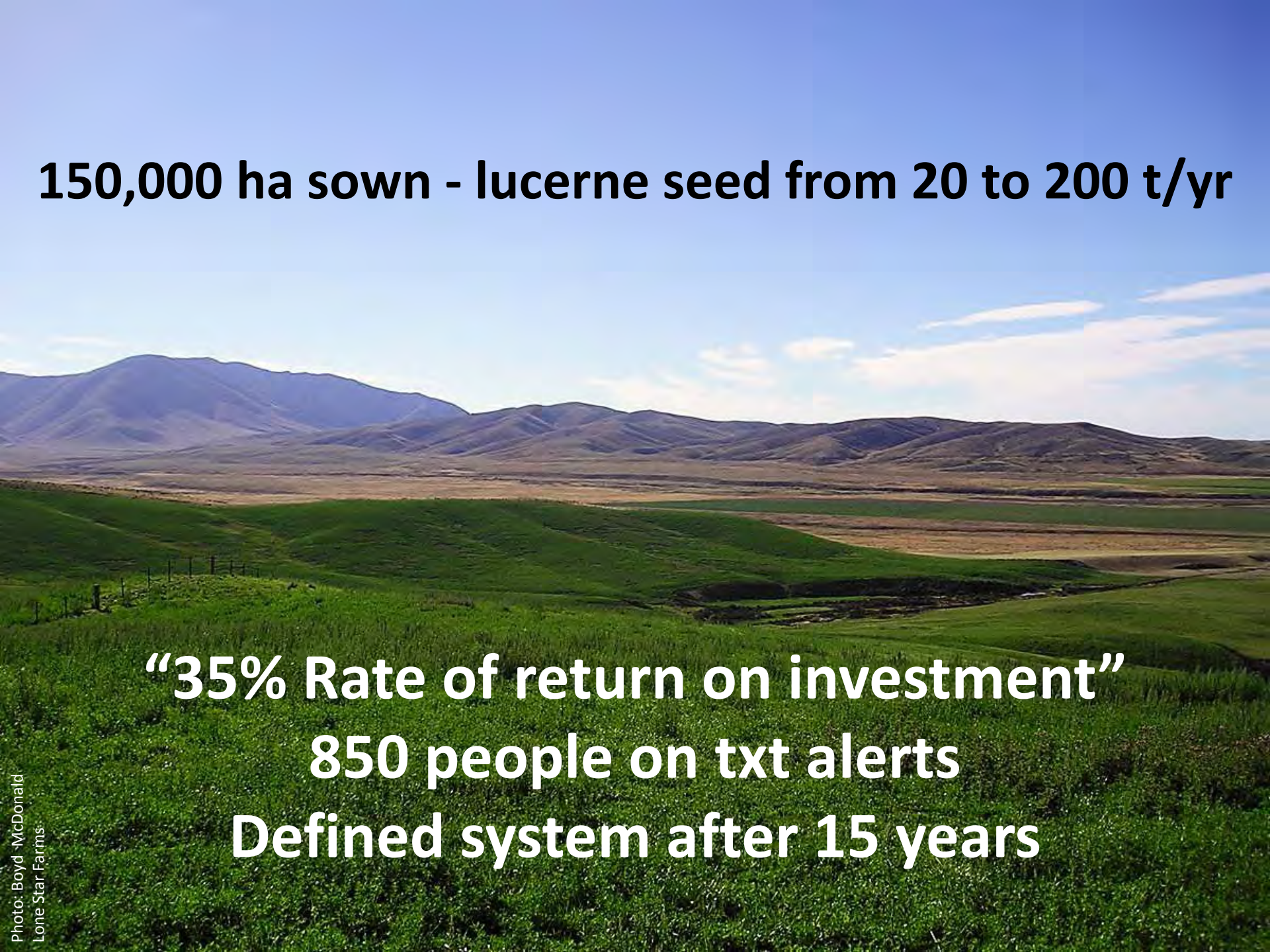
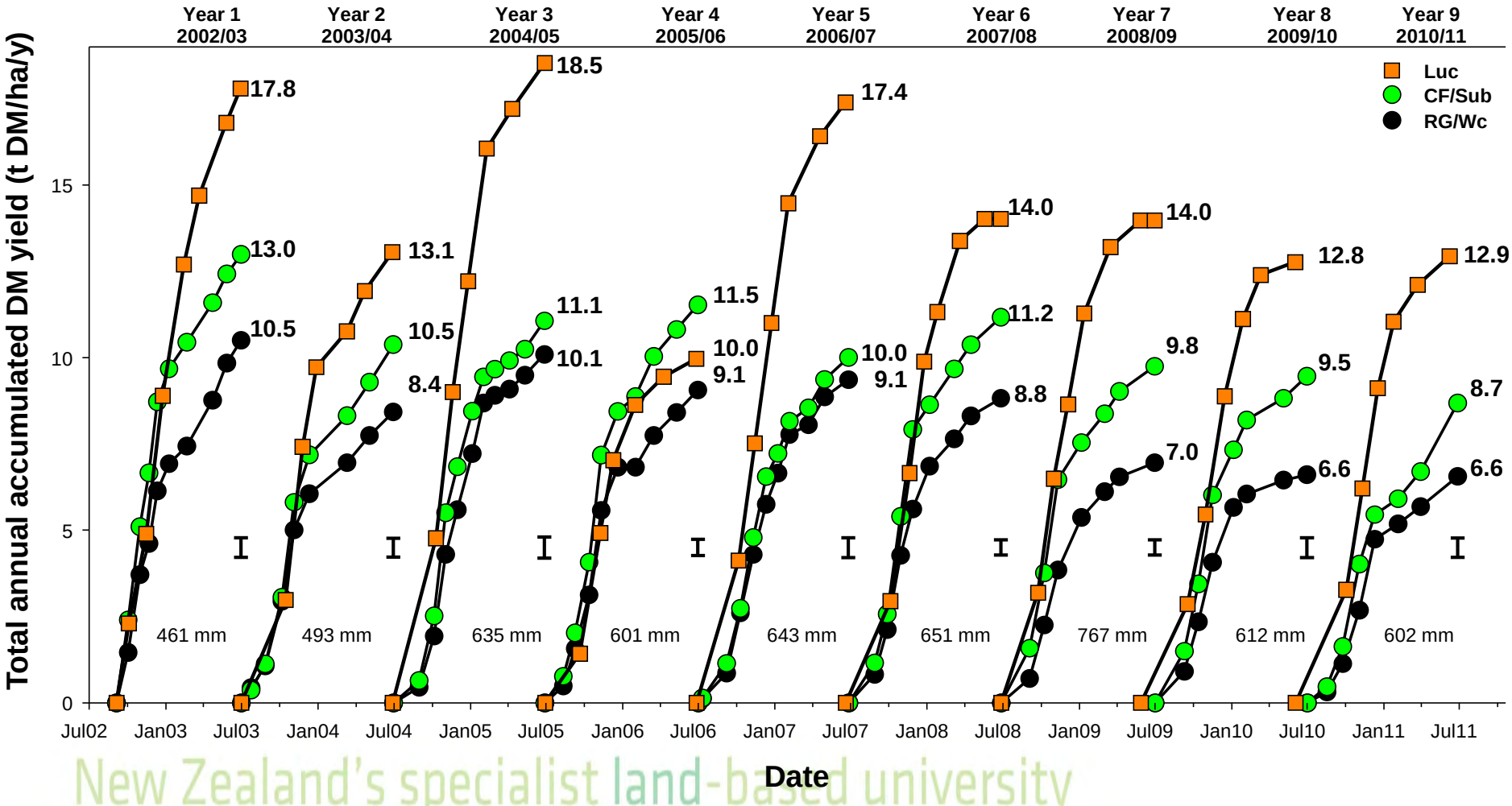
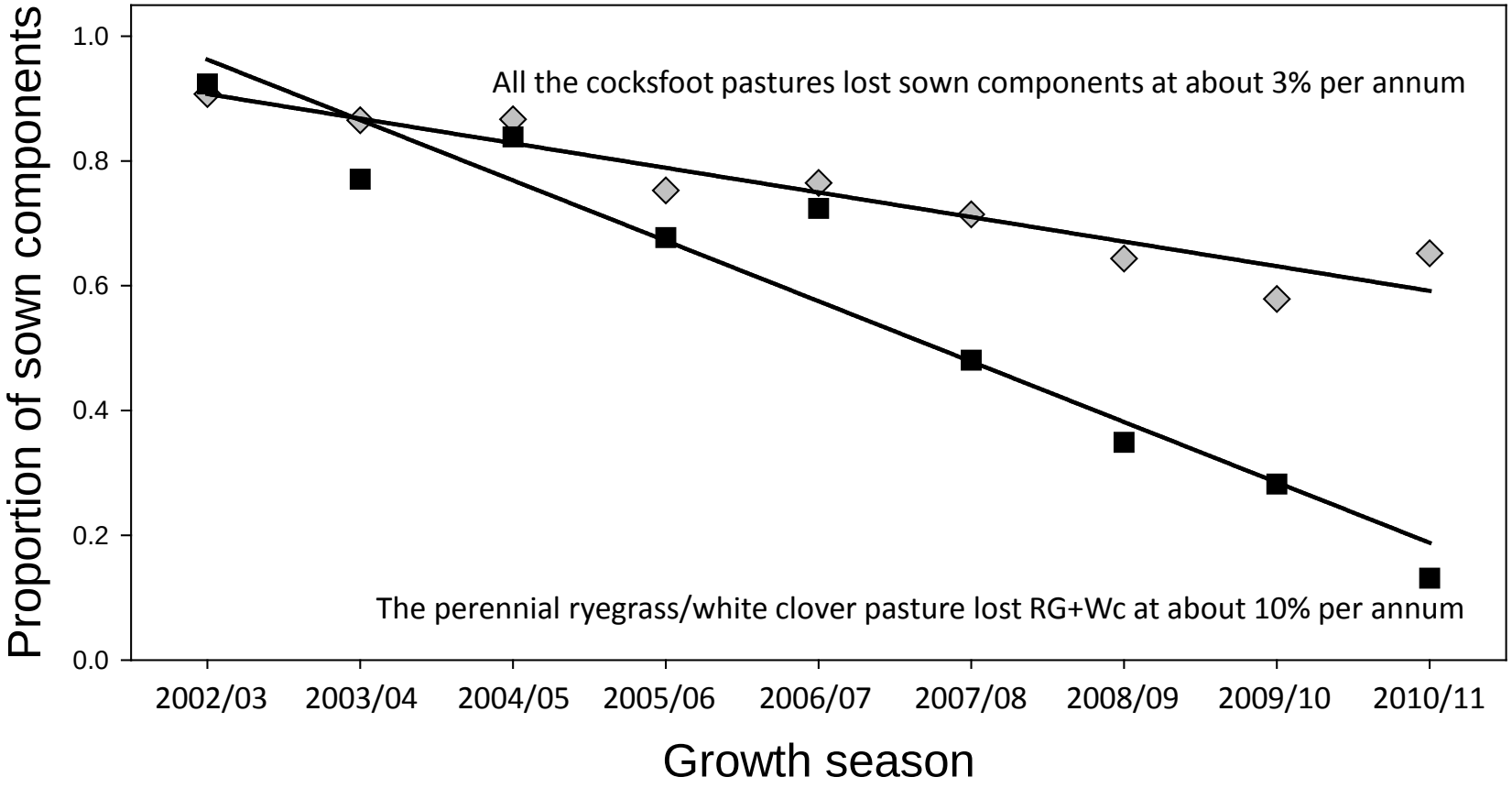

150,000 ha sown - lucerne seed from 20 to 200 t/yr
“35% Rate of return on investment”
850 people on txt alerts
Defined system after 15 years
Photo: Boyd McDonald
Lone Star Farms

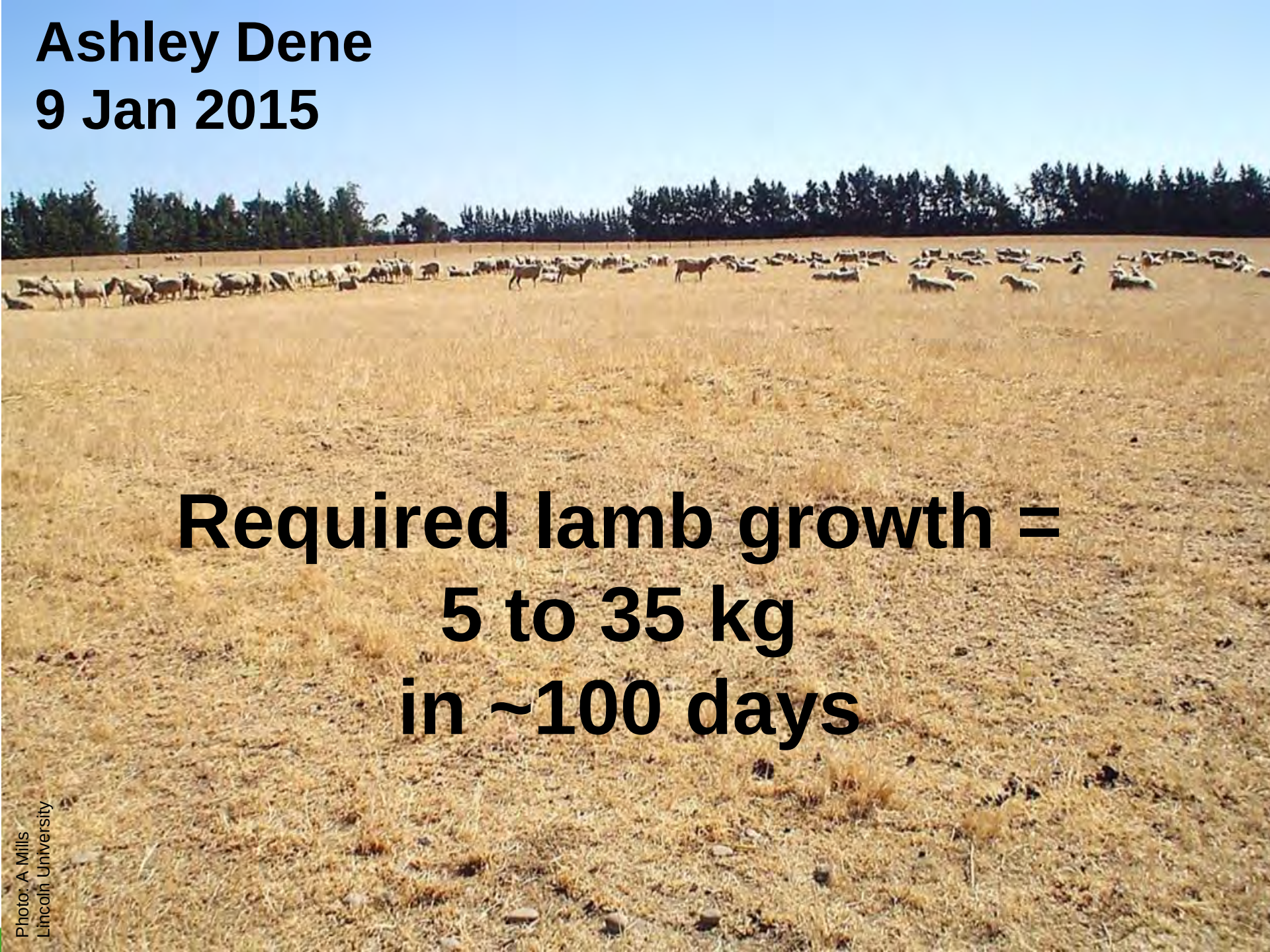
Photos: Richard Cookson

MaxClover Total DM yields



Change in the proportion of originally sown pasture components (grass + clover) over time



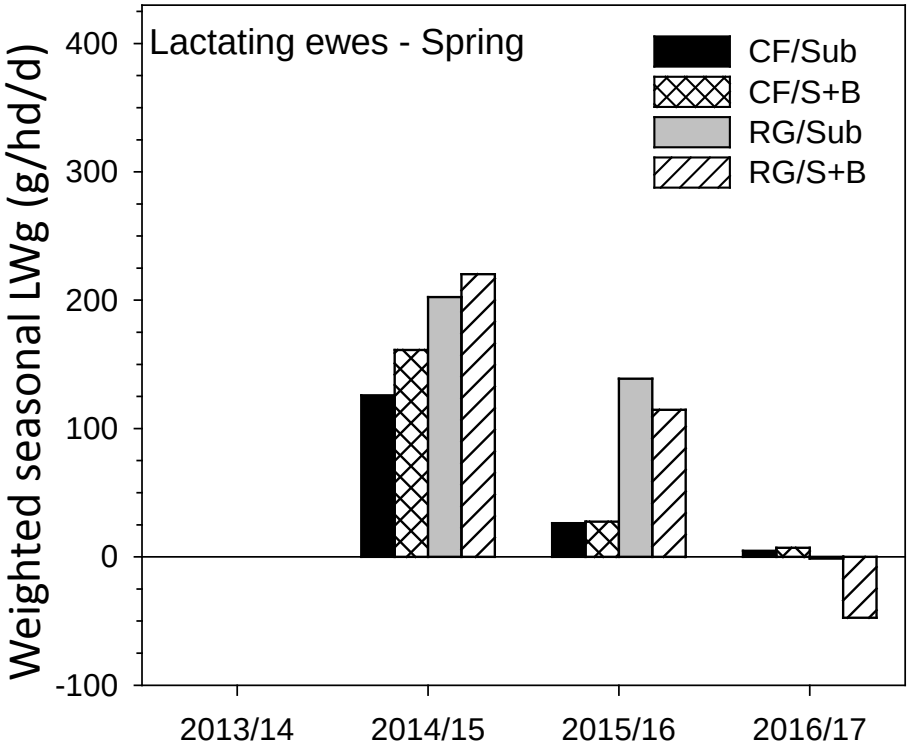

Ashley Dene
9 Jan 2015
Required lamb growth =
5 to 35 kg
in ~100 days
Photo: A Mills
Lincoln University

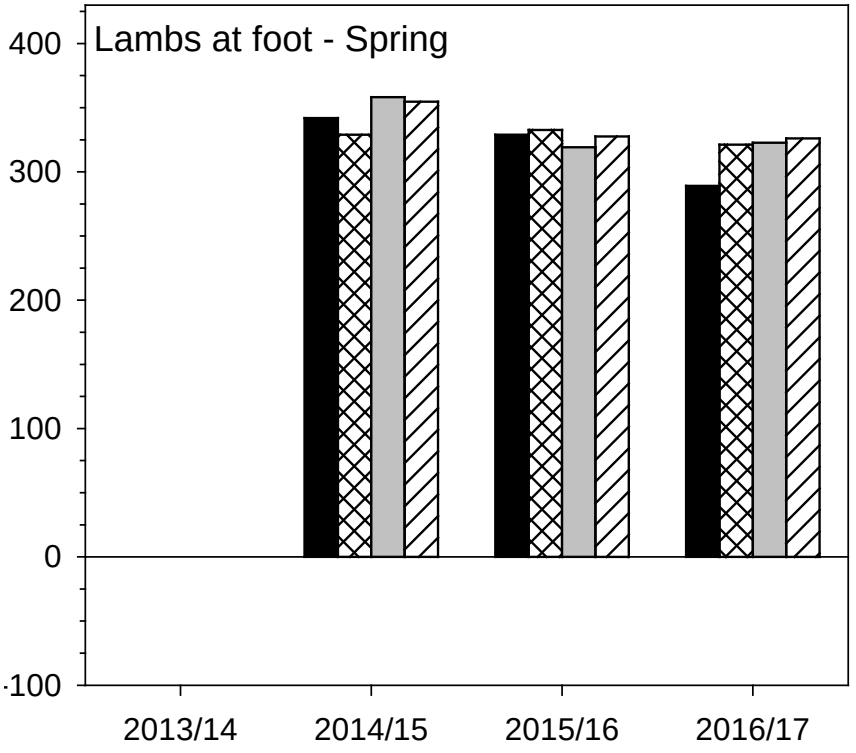

8 July 2015
Photo: Bob Lucas
Lincoln University


11 Sept 2015
Photo: A Mills
Lincoln University


23 Oct 2015
Photo: Dick Lucas
Lincoln University

MaxAnnuals

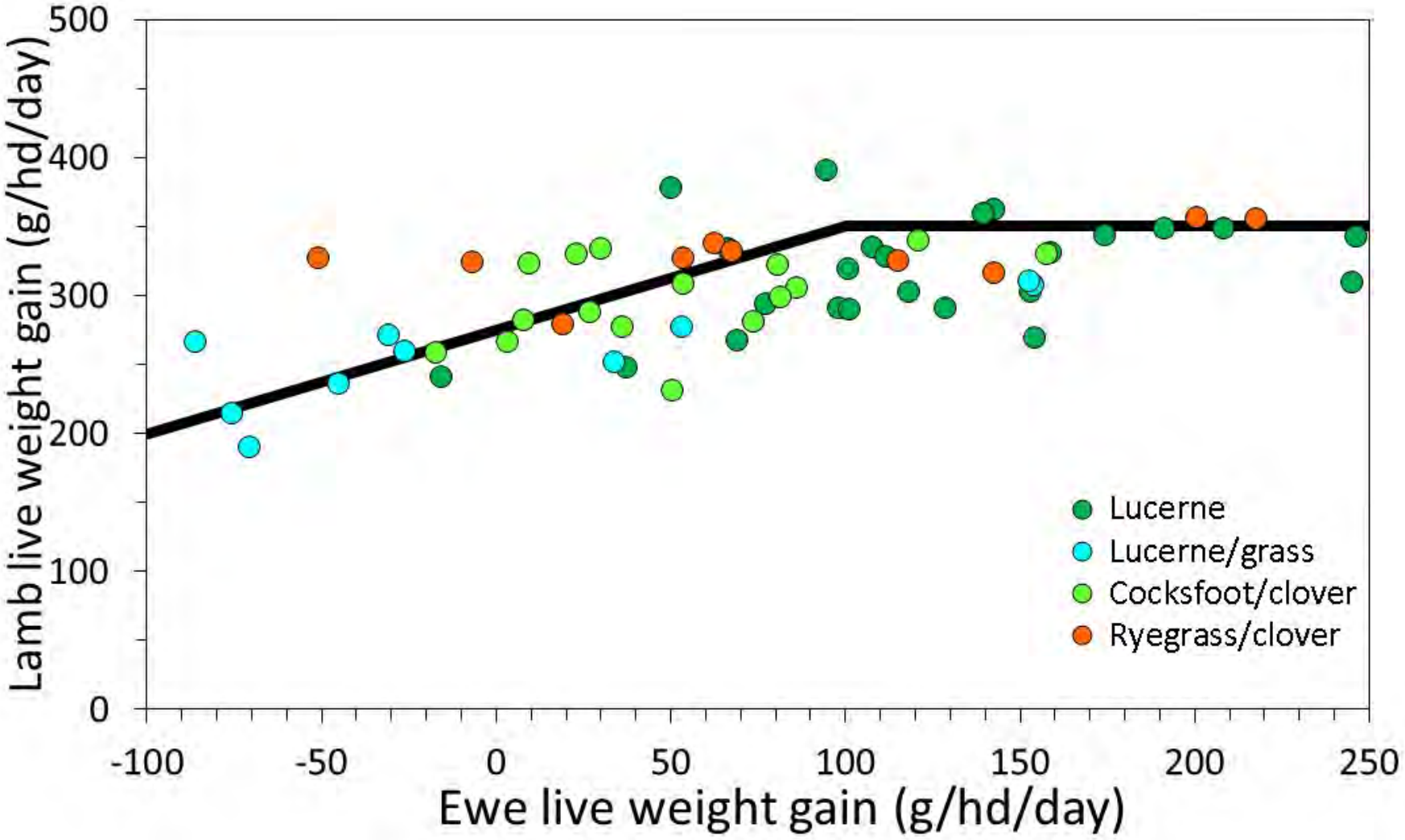




Growth Season

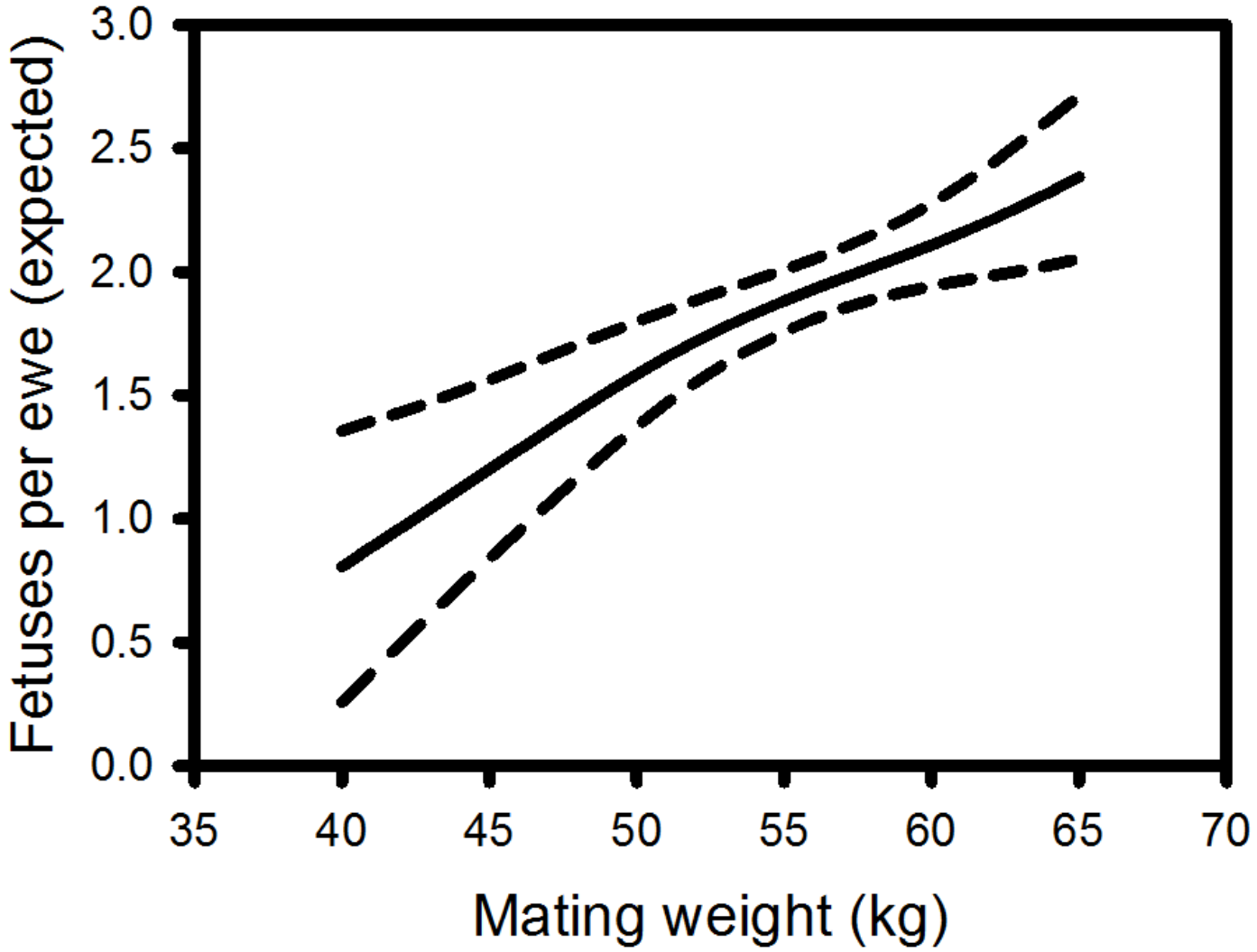
Moot et al. unpublished

Lamb LWG vs ewe LWG (g/head/day) - by pasture type



Moot et al. unpublished

Expected number of fetuses per ewe as live weight increases



Fields *et al*. 2017

Tempello

meat - wool - wine

Photo: Jo Grigg
Tempello

Uncultivated – grazing only – no seed…

Photo: A Mills
Lincoln University

Tempello, Marlborough
26/2/2016

Reap the benefits in the following years. You probably only need to repeat this every 10-15 years or so.

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Photo: Jo Grigg
Tempello

Over 560 ha Tempello Corrie area

In poor price year with $4.40/kg CW and $1.80/kg store ...
$40,000 ahead if lambs 7 kg heavier at weaning.

Tonnes meat from 60 to 76 tonnes despite fewer ewes.

LEGUMES AT MEADOWBANK

We're in clover

Will Grigg

Website: www.lincoln.ac.nz/dryland

Field Day handouts and presentations page (20 June 2013)

Photo: Will Grigg
Meadowbank

Grigg 2013

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Arrowleaf clover flowering January 2011

- **Flowering ‘Arrotas’ arrowleaf clover in January of its first summer.**
- **Sowing rate of 6 kg/ha – 2-3 kg/ha is probably enough.**
- **Seed should be mature around mid February.**

- **Lucerne/prairie grass/plantain mix in late January 2013.**
- **Sown October 2012 and first grazed late March 2013.**
- **16 ha split into five paddocks and water troughs installed.**

“Which legume drives your system?”

Photo: Doug Avery, Bonavaree

Direct drilled during the drought autumn 2017

Wet spring followed by < 20 mm of rain in Feb 2017

Photo: Derrick Moot
Lincoln University

Peri urban environment

Photo: Derrick Moot
Lincoln University
9/3/2017

Photo: Derrick Moot
Lincoln University
9/3/2017

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Photo: Derrick Moot
Lincoln University
9/3/2017

Californian thistle

Photo: Derrick Moot
Lincoln University


Photo: Derrick Moot
Lincoln University


Photo: Derrick Moot
Lincoln University


Photo: Derrick Moot
Lincoln University

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Photo: Derrick Moot
Lincoln University
17/3/2017


Photo: Derrick Moot
Lincoln University

Photo: Derrick Moot
Lincoln University

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30th August 2017


Burnt pasture area
Burnt gorse area


Photo: Derrick Moot
Lincoln University
9 March 2017

Gorse seedlings

21 April 2017

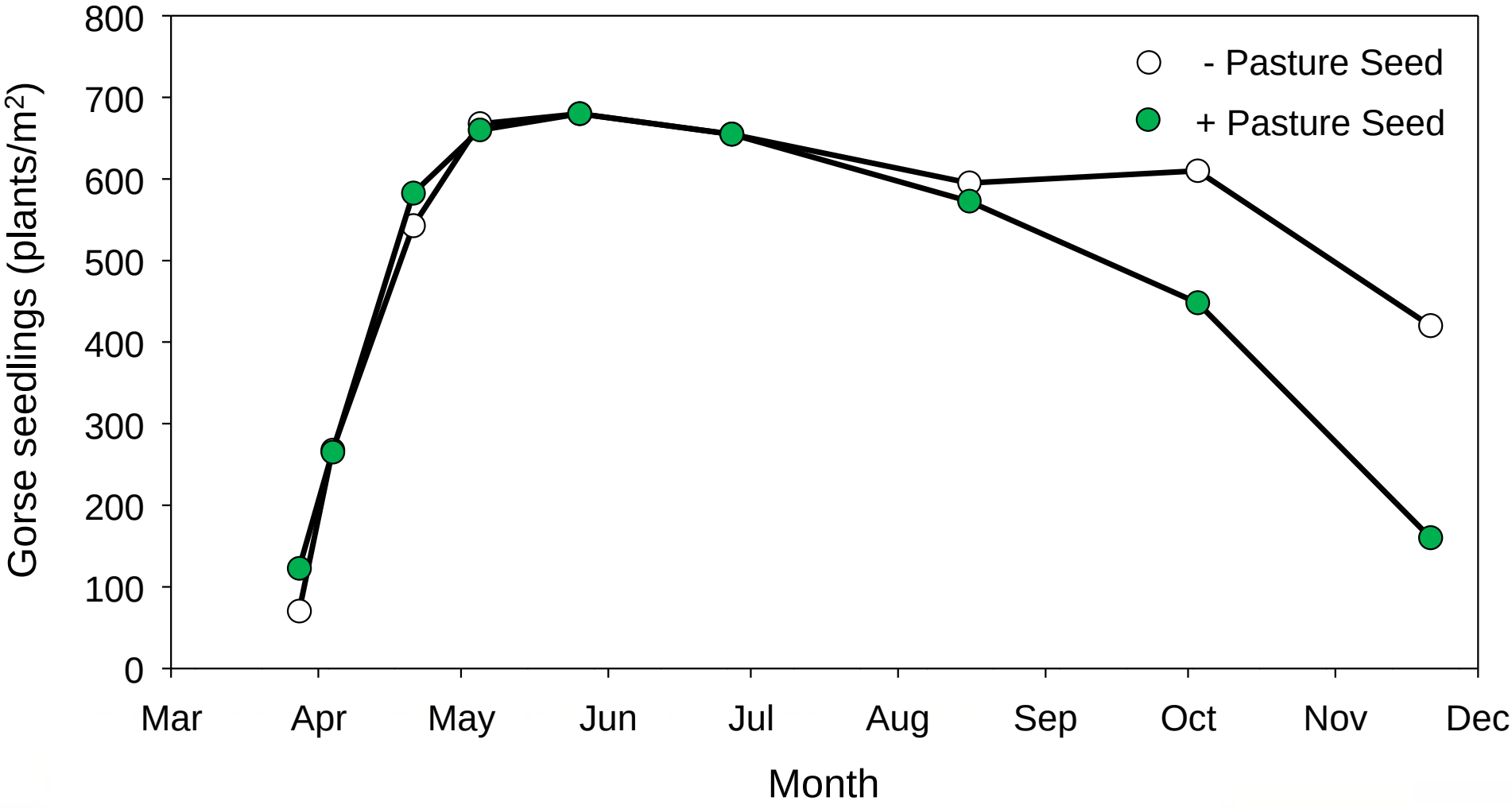

Photo: Derrick Moot
Lincoln University
0118
17 Mar 2017

Photo: Derrick Moot
Lincoln University

Gorse gully on 29 August 2017 –South slope

Gorse gully on 29 August 2017 –South slope

Gorse seedling population over time with or without oversown pasture following fire



High Country Pastures

Photo: DJ Moot
Lincoln University

NEW ZEALAND merino

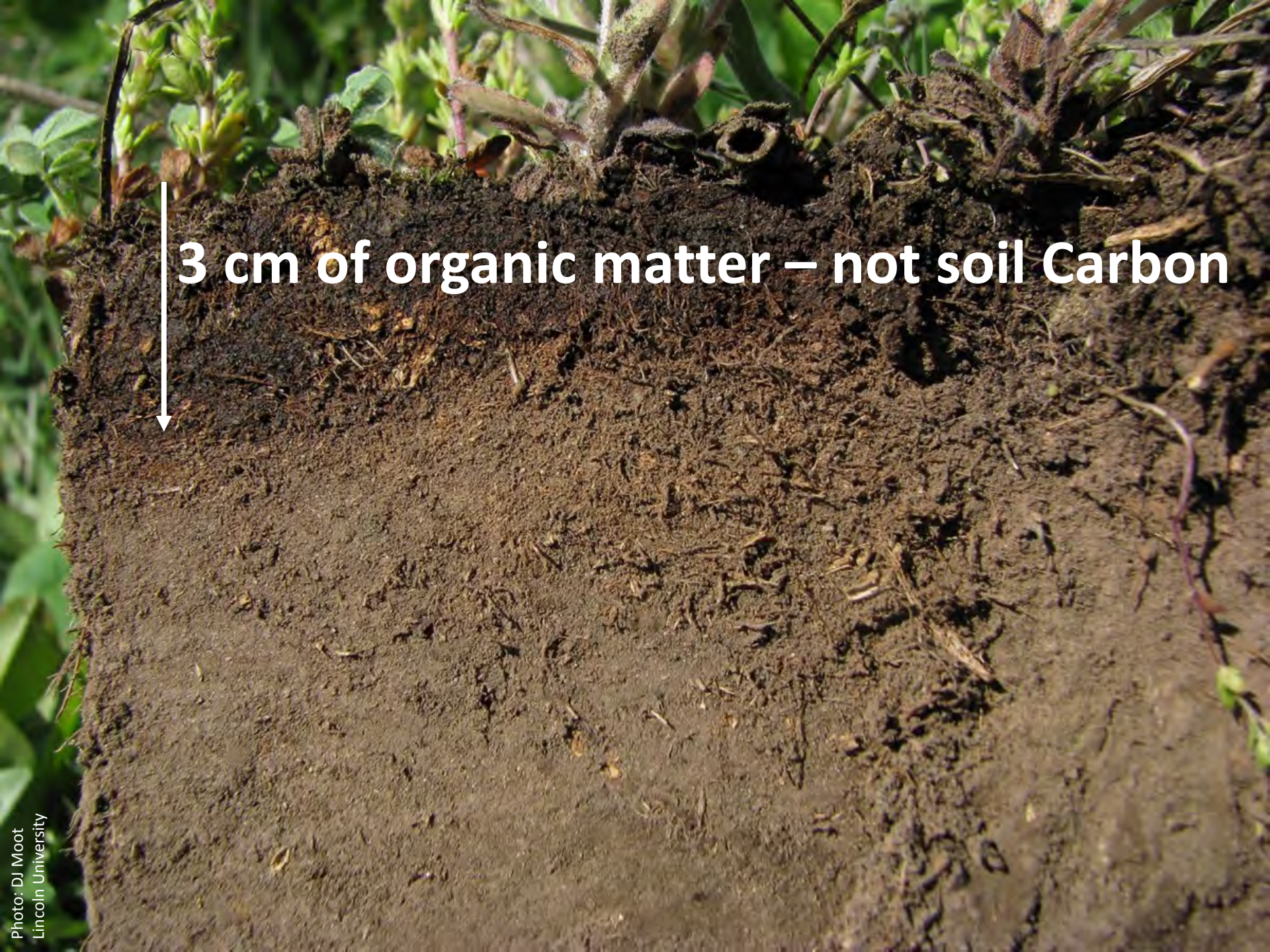


Photo: DJ Moot
Lincoln University

Photo: DJ Moot
Lincoln University

Browntop – *Agrostis capillaris* – stolons and rhizomes

Autumn herbicide and burn

ne - Lucerne

Photo: KM Pollock
Lincoln University

Photo: DJ Moot
Lincoln University

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Photo: D Hendrie
Lincoln University
FLEXISEEDER®
www.flexiseeder.com
AGMARDT
ENABLING TRANSFORMATIONAL
INNOVATION

Paddocks of lupin

- Sown December 2013
- After 1 year of ryecorn

Photo: KM Pollock
Lincoln University

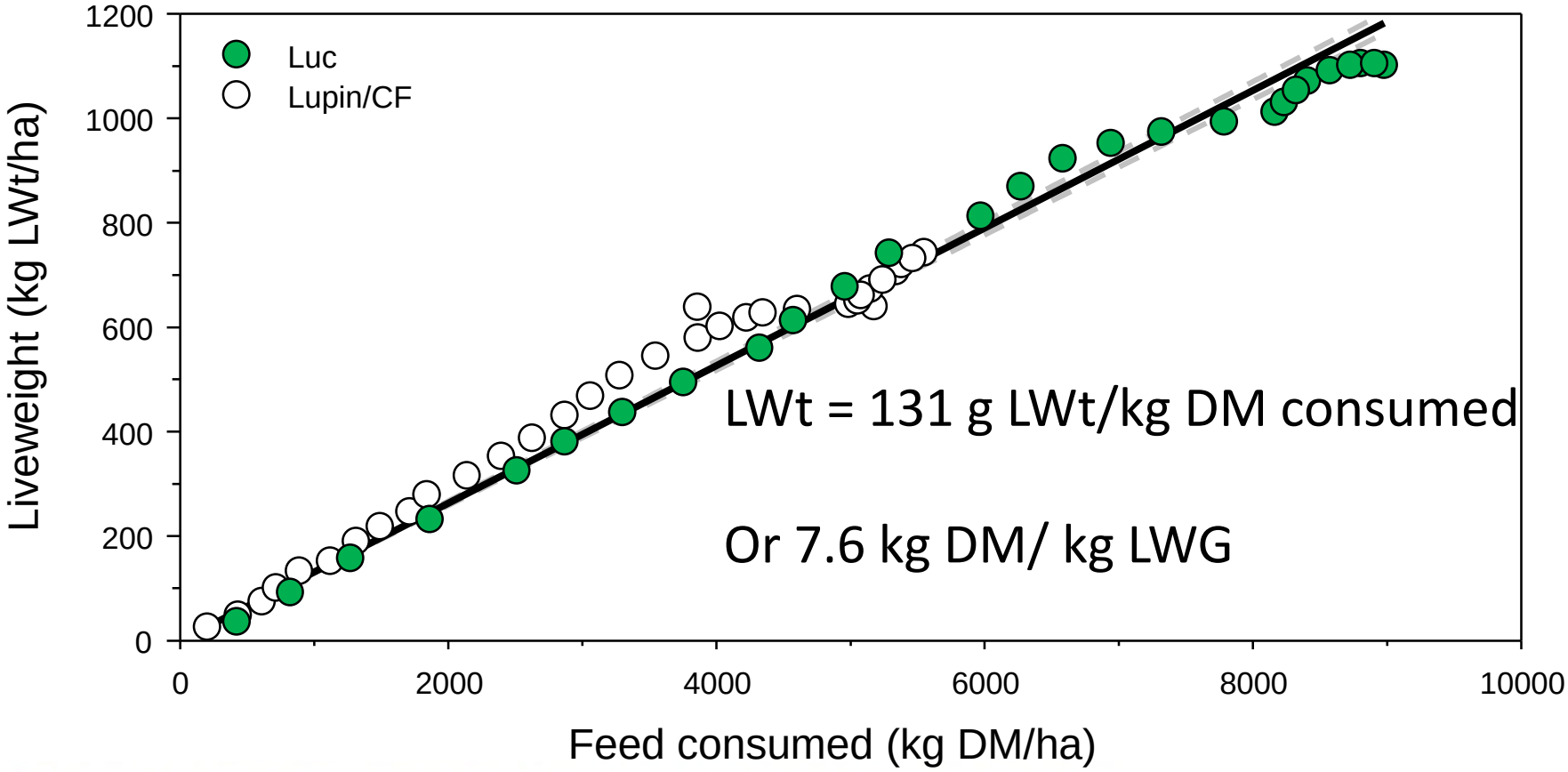
Seedlings @ 6 weeks after sowing

Caucasian clover and cocksfoot included in the seed mix

4 months after sowing

Lambs to lupins: 31 Oct 2014

Relationship between LWt production and feed consumed



T Ryan-Salter unpublished

Sheep prefer 70% legume, 30% grass

Photo: Jo Grigg
'Tempello' Marlborough

Legume options for Sth Otago

- Lower ryegrass sowing rates
- Temporal separation – timothy + red
- Protein injected pastures – overdrill sub
- Balansa clover after winter feed
- Specialist finishing pastures of plantain + red
- Chicory – large tap root?
- Local agronomic research required – Gore?

N deficient North Island Hill Country!

New Zealand's specialist land-based university

Photo: DJ Moot
Lincoln University
April 2017

North Island – mudstone and sandstone soils

Plantain + red, white or sub clover ?

Energy requirement (MJ ME/kg) for lamb growth from 25 to 35 kg liveweight

Lamb growth rate (g/hd/d)	Energy per lamb per day	Days on farm	Energy consumed per lamb
100	13	100	1300
200	17	50	850
300	22	33	726

MJ ME: megajoules of metabolisable energy

(based on Brown 1990)

40% White clover

Photo: DJ Moot
Lincoln University

White clover

- Small seed (0.63 mg)
- Rapid germination and emergence but:
- Small seedling – needs light to produce leaves

- Establishment experiment (chicory 1.5 kg/ha)
  - 4 dates = 4/2, 26/2, 19/3, 9/4
  - 5 rates = 0, 4, 8, 12, 16 kg/ha ryegrass

Seedlings at 28 DAS

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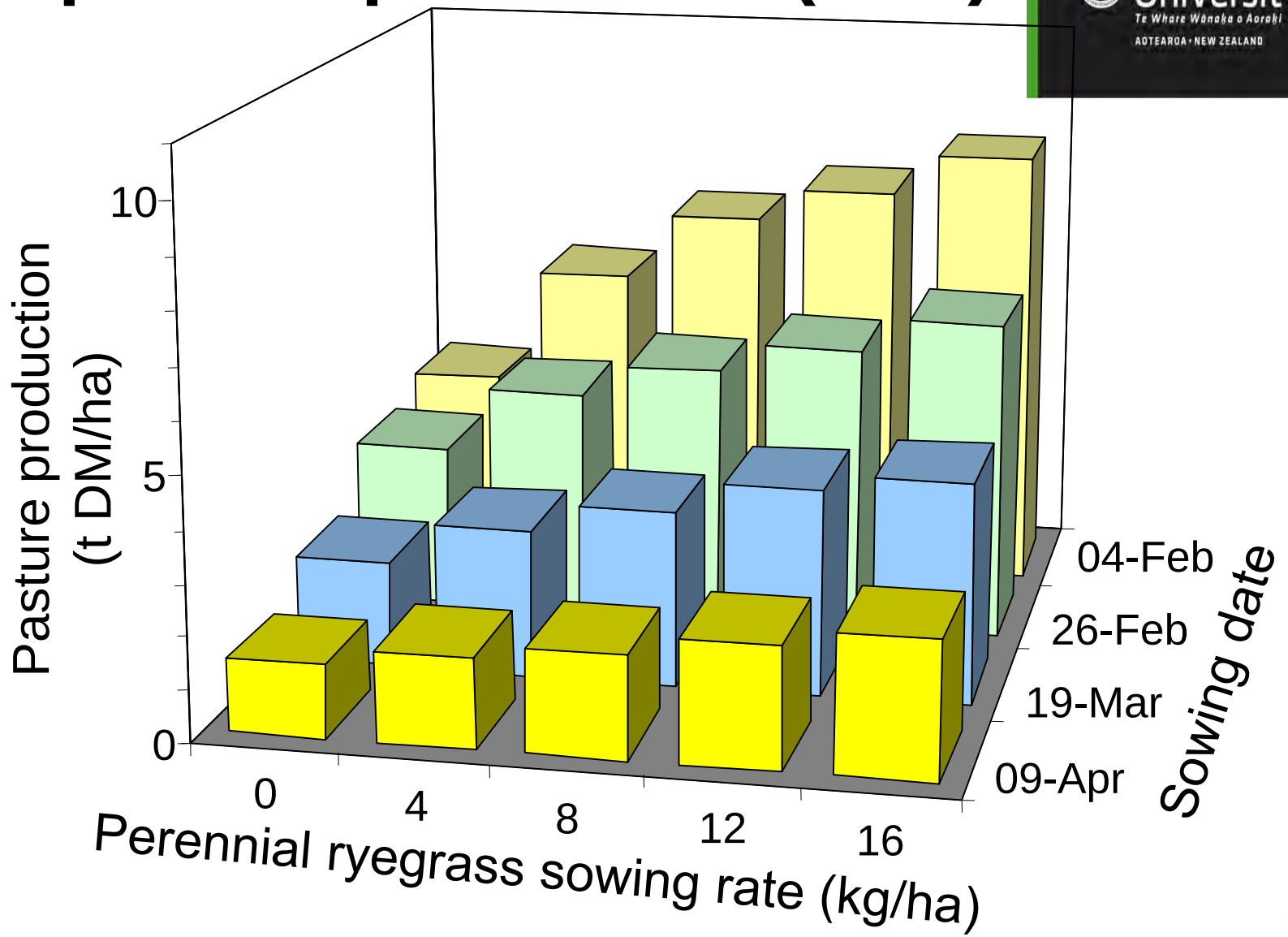
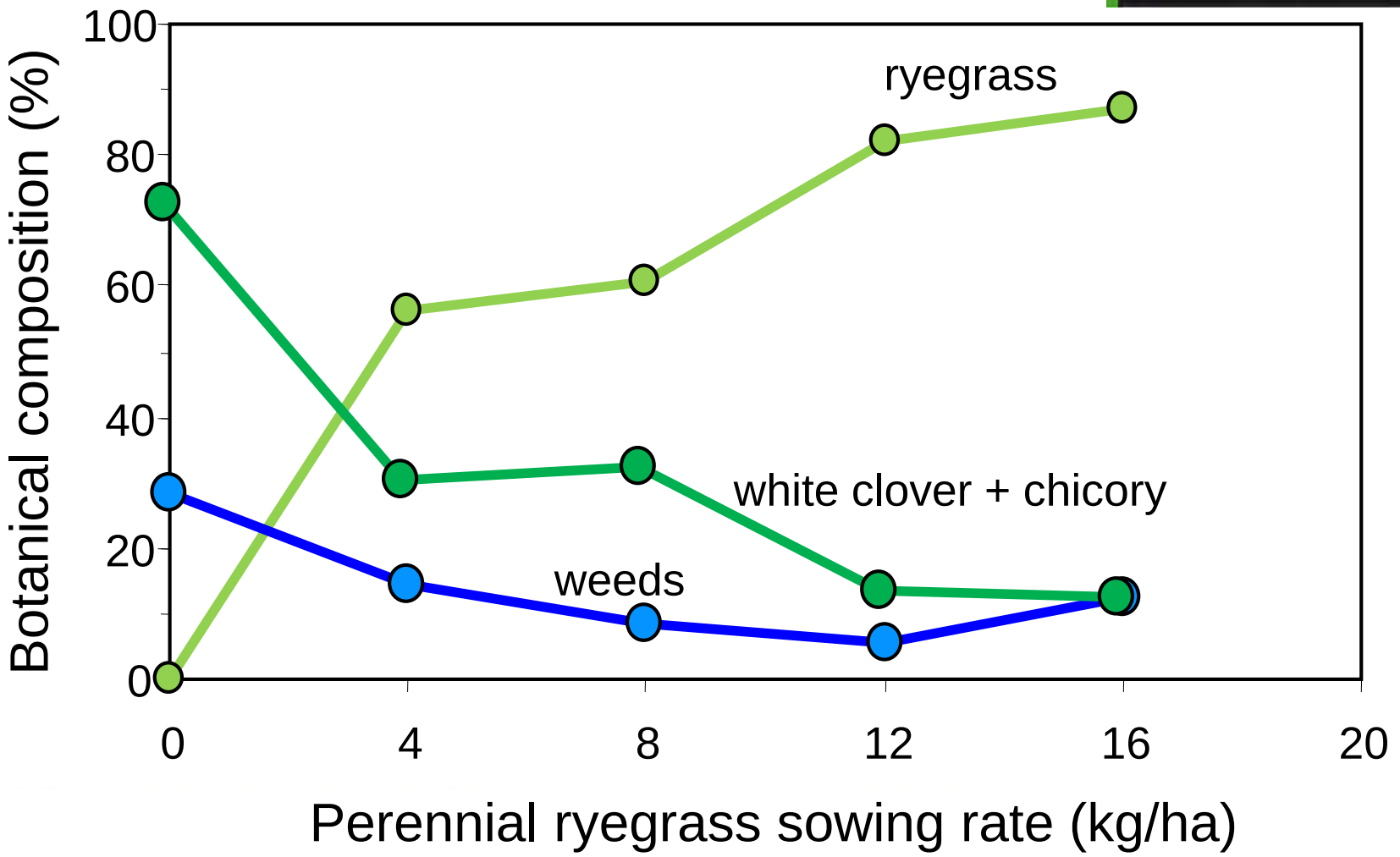
Photo: D Hollander & AD Black
Lincoln University

Total pasture production (25/9)



Nicholls 1998

Botanical composition

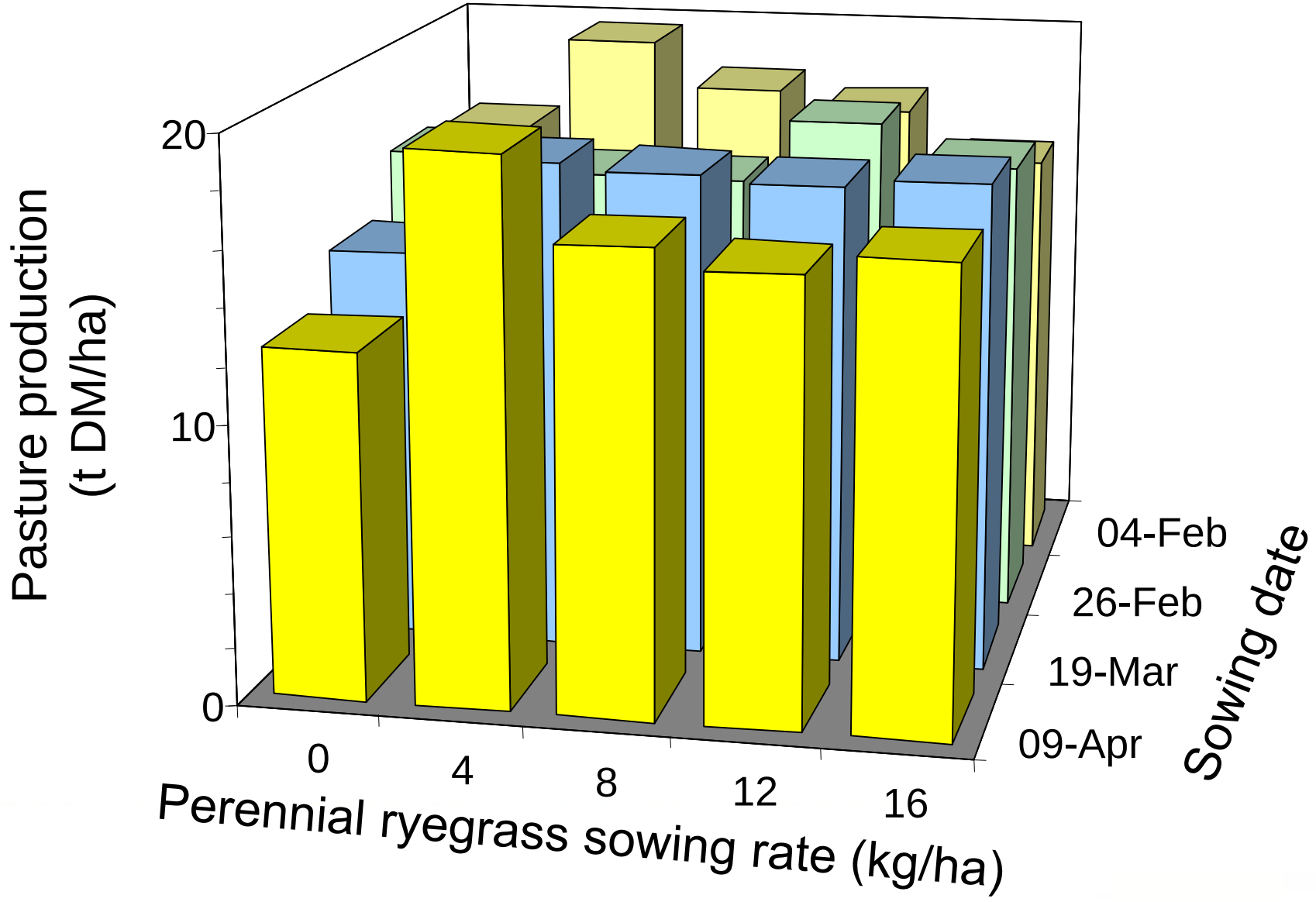


Nicholls 1998

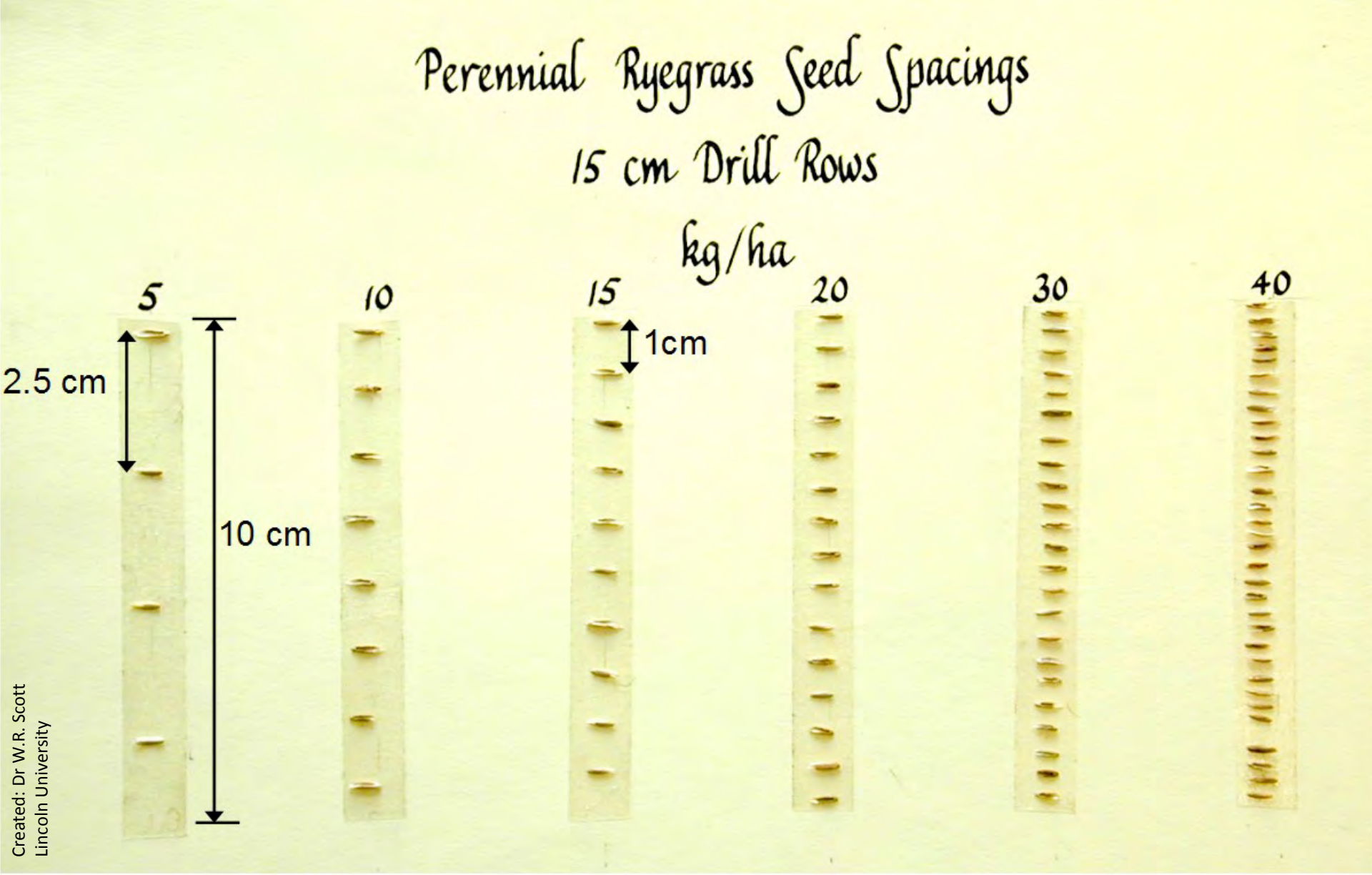
Number of seeds sown /m²

Ryegrass (kg/ha)	Ryegrass (seeds/m²)	White clover (3 kg/ha)	Chicory (1.5 kg/ha)	Total (# of seeds)
0	0	420	120	540
4	200	420	120	740
8	400	420	120	940
12	600	420	120	1140
16	800	420	120	1340
20	1000	420	120	1540

Total pasture production in second year

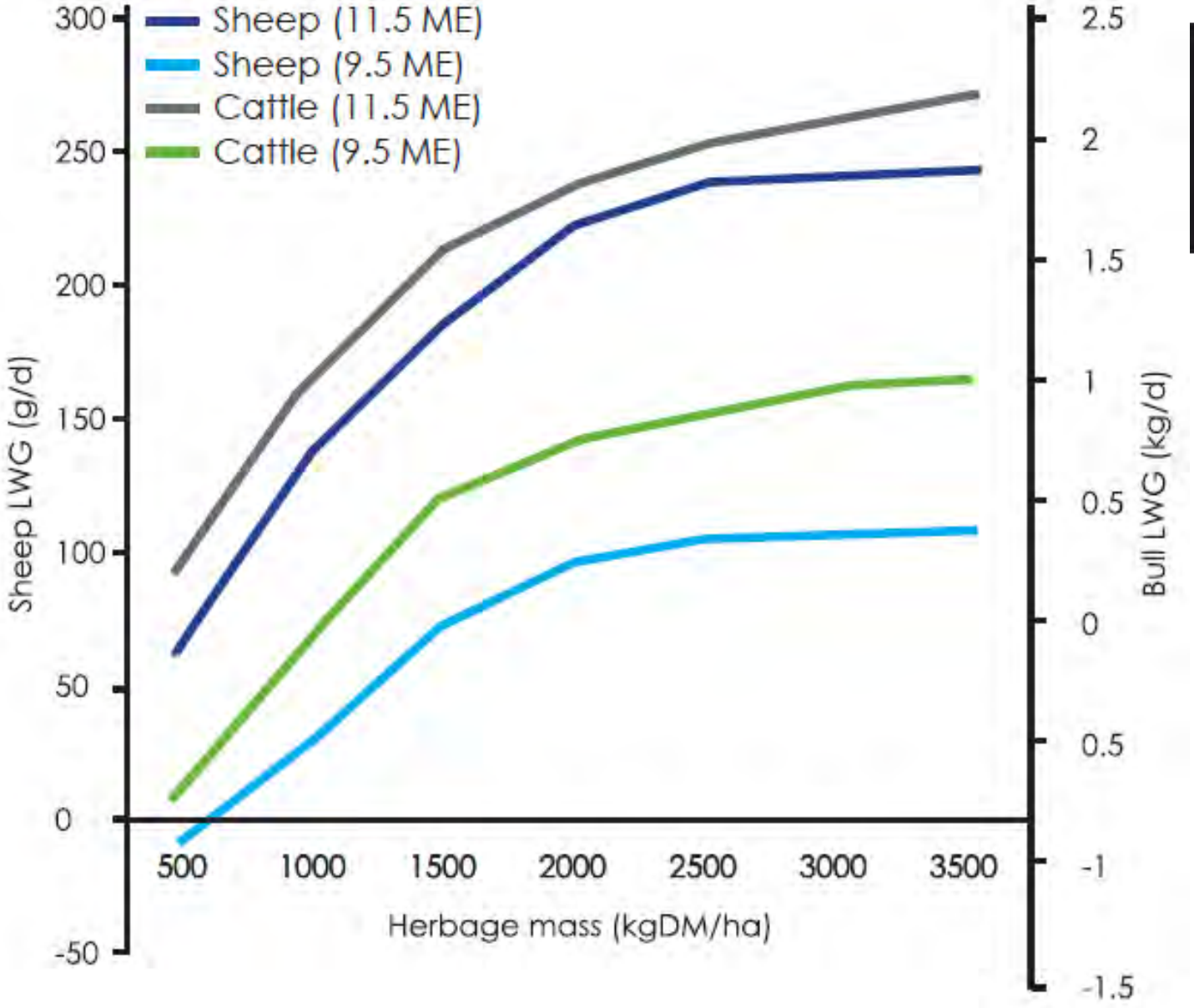


Nicholls 1998


Perennial Ryegrass Seed Spacings
15 cm Drill Rows
kg/ha
5
10
15
20
30
40
2.5 cm
10 cm
1cm
Created: Dr W.R. Scott
Lincoln University

Hurst *et al*. 2000

High clover but too short?



Generalised relationship between pasture herbage mass and live weight gain of animals.

Beef + Lamb New Zealand. 2012. Pasture quality: Principles and management / The Q-Graze manual. Accessed 29/09/2017.
https://beeflambnz.com/knowledge-hub/PDF/pasture-quality-q-graze

Conclusions

- Nitrogen drives pasture production
- N from legumes drives animal production
- Successful legume based dryland systems
- Transfer to summer safe areas requires;
    - increased legume content
    - higher pasture covers for grazing ?
    - alternative pasture species?
    - courage to implement change

References

Bonoma, T. V. 1985. Case research in Marketing: Opportunities, problems and a process. *Journal of Marketing Research*, **22**, 199-208.

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