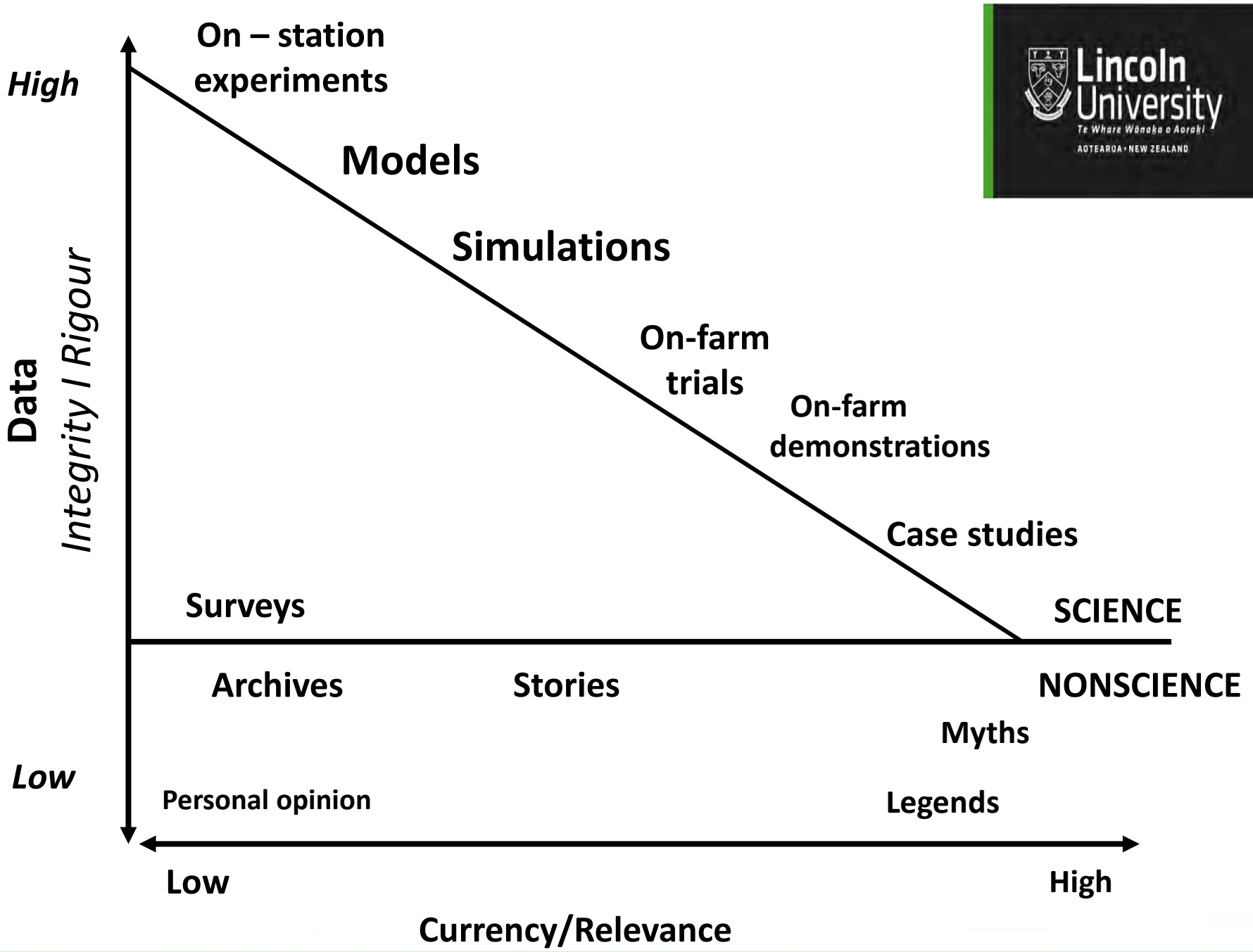
Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH·NEW ZEALAND

Lucerne Update

Derrick Moot



New Zealand's specialist land-based university


On – station experiments
High
Models
Simulations
On-farm trials
On-farm demonstrations
Case studies
Data
Integrity I Rigour
Surveys
SCIENCE
Archives
Stories
NONSCIENCE
Myths
Low
Personal opinion
Legends
Low
High
Currency/Relevance

Bonoma 1985

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

"Lucerne where possible"

Experiment site

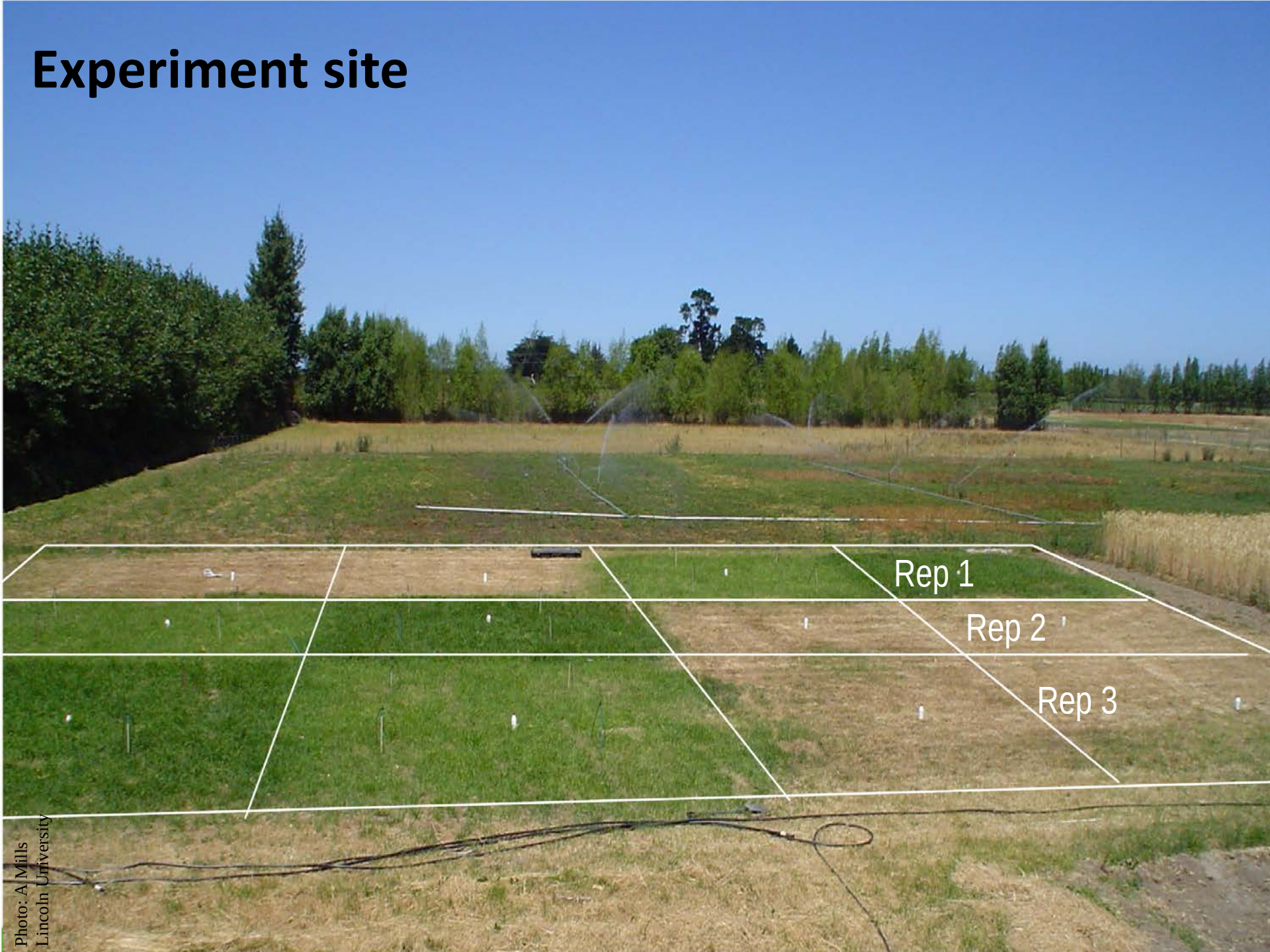
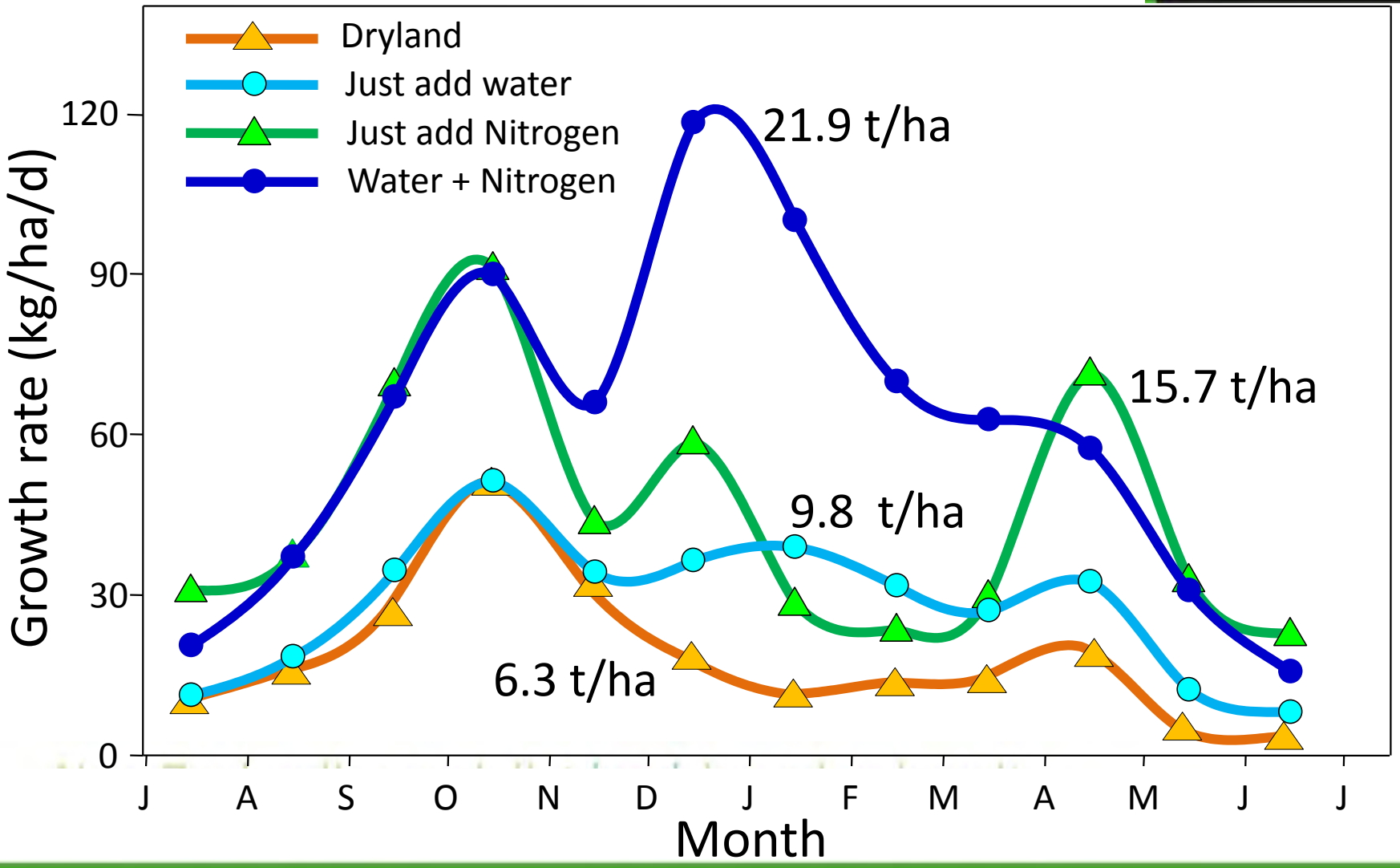


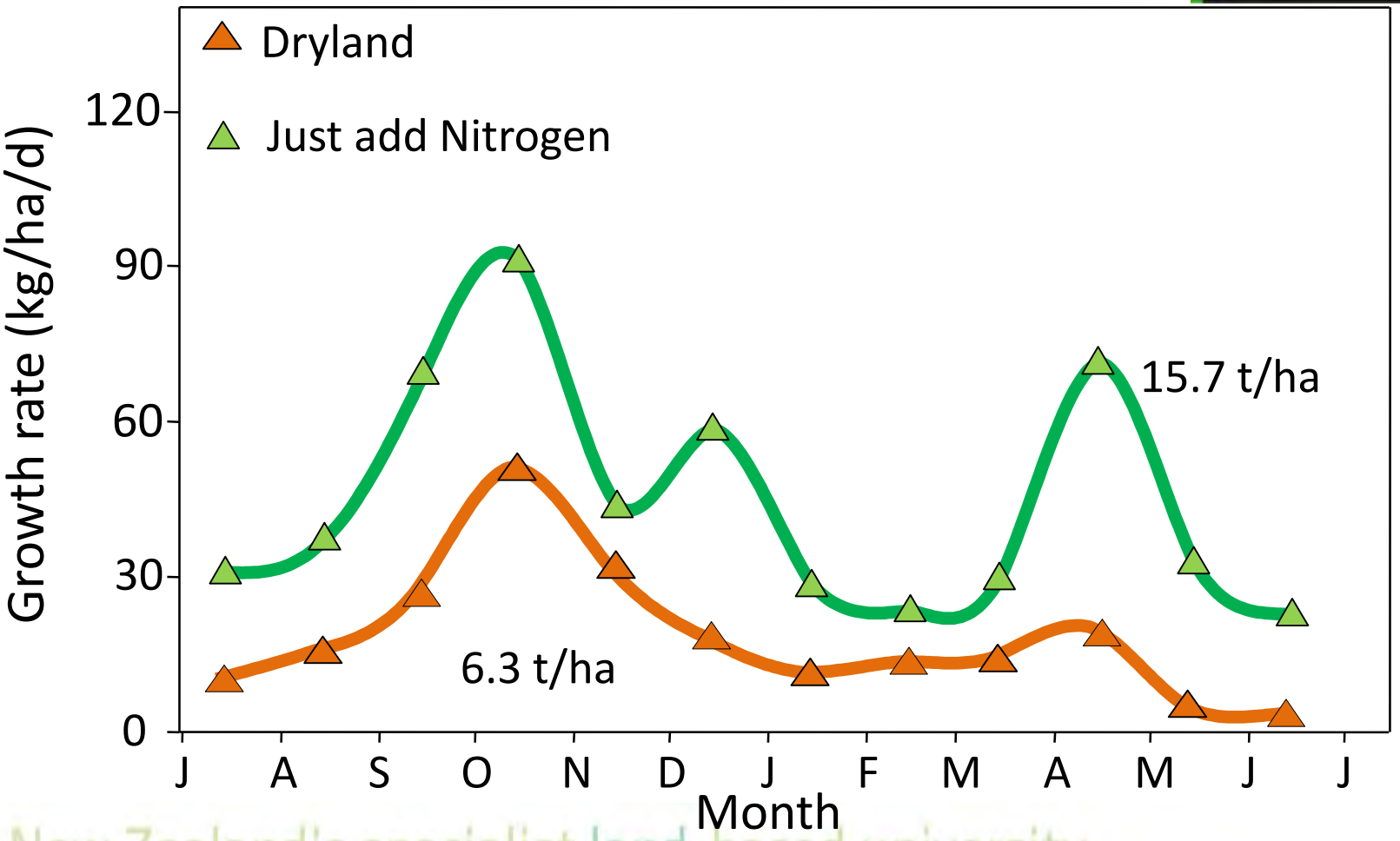
Photo: A Mills
Lincoln University

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

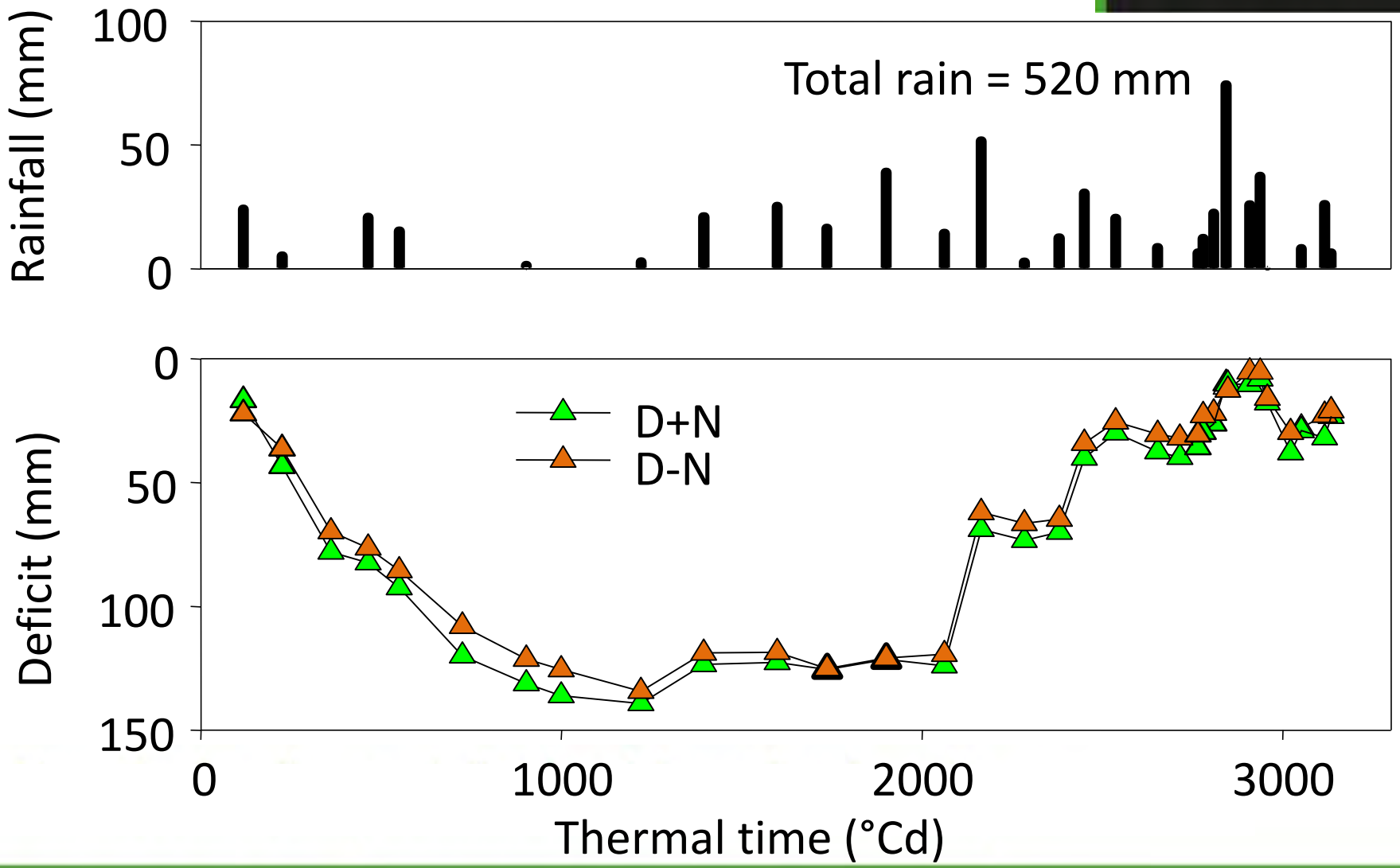
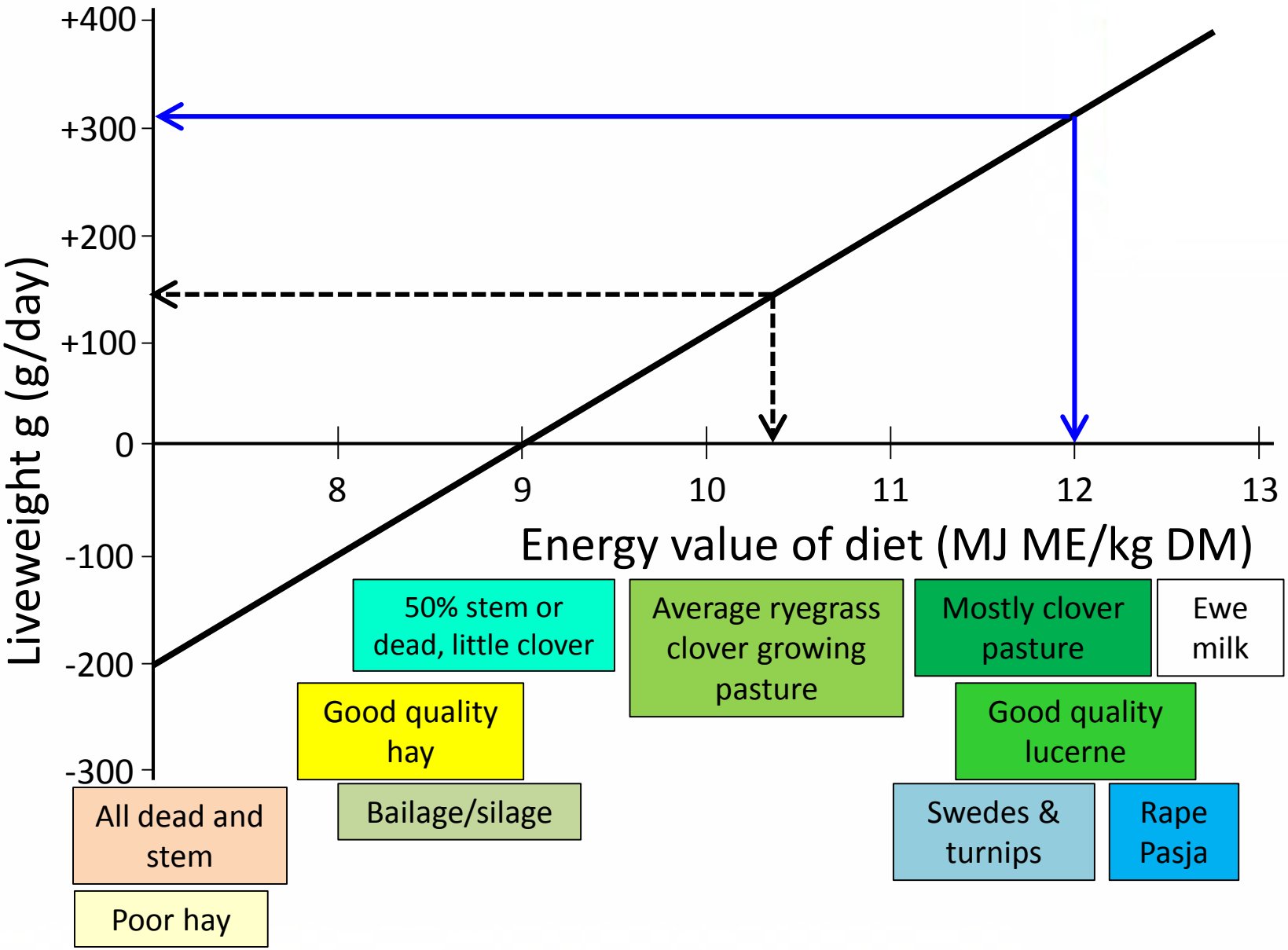


Photo: DJ Moot
Lincoln University

Nitrogen fixation
25-30 kg N/t DM

Photo: DP Monks
Lincoln University

Lucas *et al*. 2010



Lucerne Objectives

- Describe key establishment issues.
- Describe management to maximise production, quality and persistence.
- Answer any question

Resistance to Pests and Diseases

Cultivar		Dormancy	BGA	PA	SAA	BW	SN	PRR	VW	LD
Grasslands	Kaituna	I	R	R	R	R	R	R	-	MR
Grasslands	Otaio	I	R	R	R	R	R	R	-	S
Grasslands	Torlesse	D	HR	R	R	R	-	R	-	MR
P54Q53		D	MR	MR	MR	HR	HR	HR	-	-
P54V09		D	-	HR	R	HR	HR	HR	HR	-
Runner		D	-	-	-	R	-	S	-	-
Wairau		SD	S	S	S	S	S	S	S	S
WL 325HQ		I	R	R	R	R	MR	R	-	-

BGA = Blue-green aphid
PA = Pea aphid
SAA = Spotted alfalfa aphid
BW = Bacterial Wilt
SN = Stem nematode
PRR = Phytopthora root rot
VW = Verticillium wilt
LD = Leaf diseases
D = Dormant
HR = 50%+ resistant
R = Resistant = (31-50%)
SD = Semi-dormant
MR = 16-30%
S = Susceptible

Establishment

Soils - deepest free draining soils
- pH 6.0
- RG/Wc fertility

Sowing - 8-10 kg/ha
- 10-25 mm
- peat inoculated 8-10 kg/ha
- ***spring*** *or* ***autumn*** *???*
- cultivated/direct drilled (DAP)

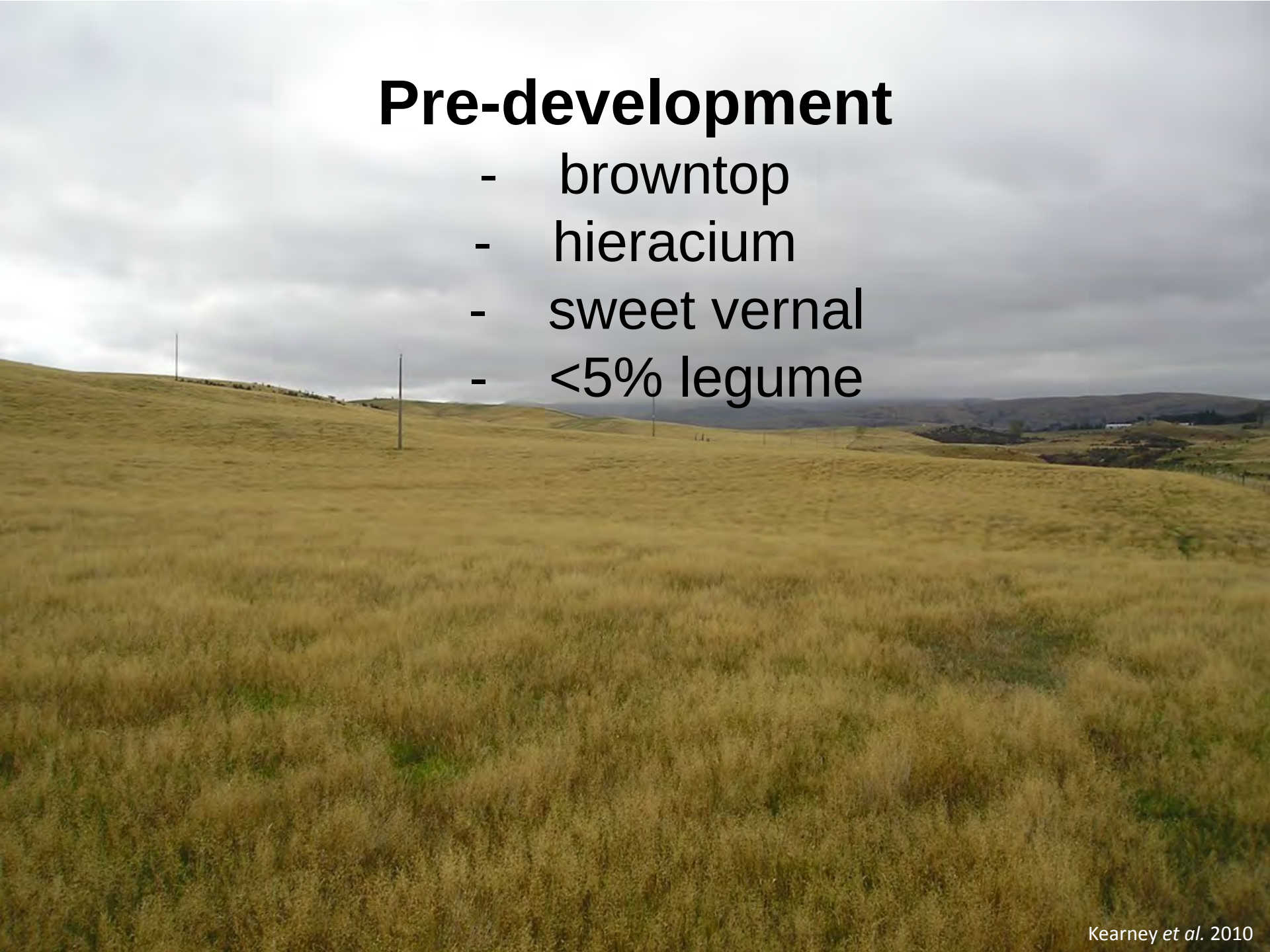
Photo: David Hollander
Lincoln University

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND

Lucerne root
~8 months after sowing
> 1.5 m length

Pre-development

- browntop
- hieracium
- sweet vernal
- <5% legume



Kearney *et al.* 2010

Lime and Fertiliser Application

Lime 3-5 t/ha

Fertiliser 250-500 kg/ha

Kearney *et al.* 2010

Soil test results (0.15 m)

	pH	Olsen P (ug/ml)	Potassium (QTU)	Sulphur (ug/g)	Aluminium (mg/kg)
Pre-Development (2008)					
Hills Creek	5.2	10	5	14	2.6
Huntleigh	5.2	10	5	1	6.3
Styx	5.2	13	13	3	5.7
Post-Development (2010)					
Hills Creek	5.8	19	9	31	0.9
Huntleigh	6.0	18	4	25	1.5
Styx	6.1	29	13	23	1.1

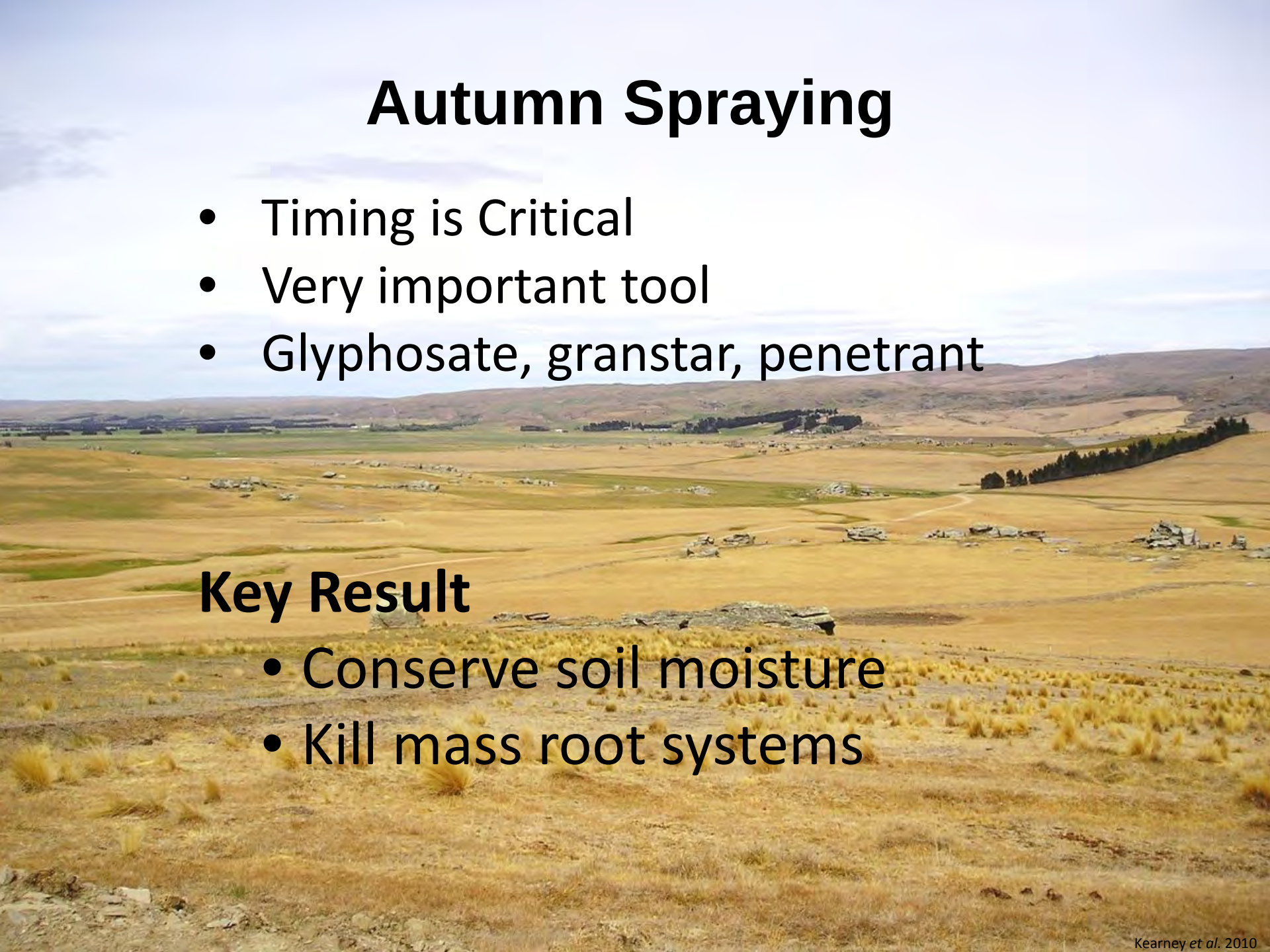
Kearney *et al.* 2010

Autumn Spraying

- Timing is Critical
- Very important tool
- Glyphosate, granstar, penetrant

Key Result

- Conserve soil moisture
- Kill mass root systems



Kearney *et al.* 2010

2nd Spray – Spring

Glyphosate, insecticide, penetrant

Result from Autumn spray, photo taken 1 November 2010

Kearney *et al.* 2010

Drilling seed with fertiliser
Direct drilling = seed + fertiliser

Kearney *et al.* 2010

Browntop – *Agrostis capillaris* – stolons and rhizomes

Autumn herbicide and burn

Photo: DJ Moot
Lincoln University

Ryecorn – *Secale cereal*

Break feed in winter/spring

Sowing rate and date

Established 2007 LU – Templeton silt loam

Coated 'Grasslands Kaituna' lucerne.

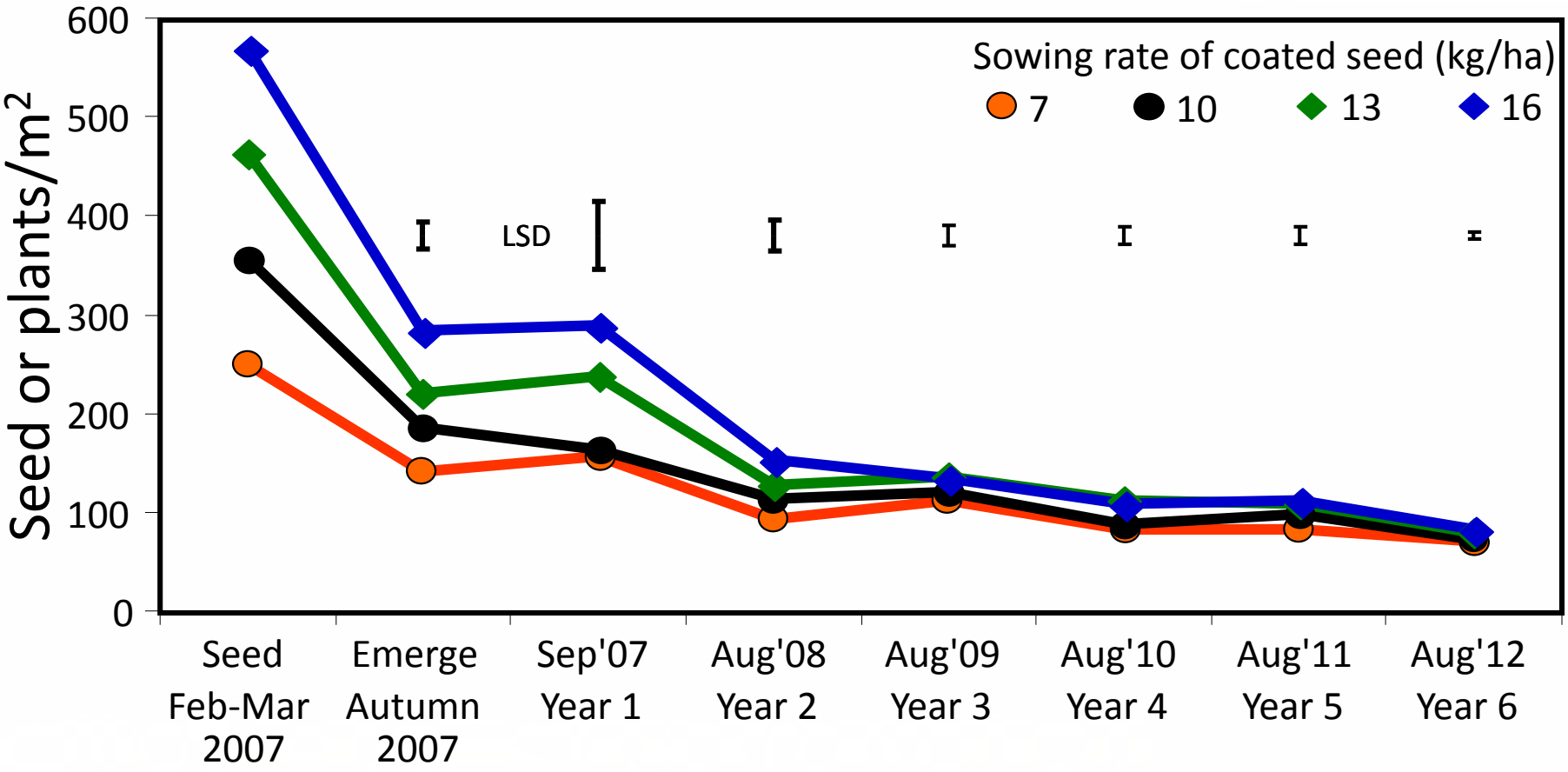
Four sowing dates

- 21 February,
- 2 March,
- 16 March and
- 30 March

Four sowing rates

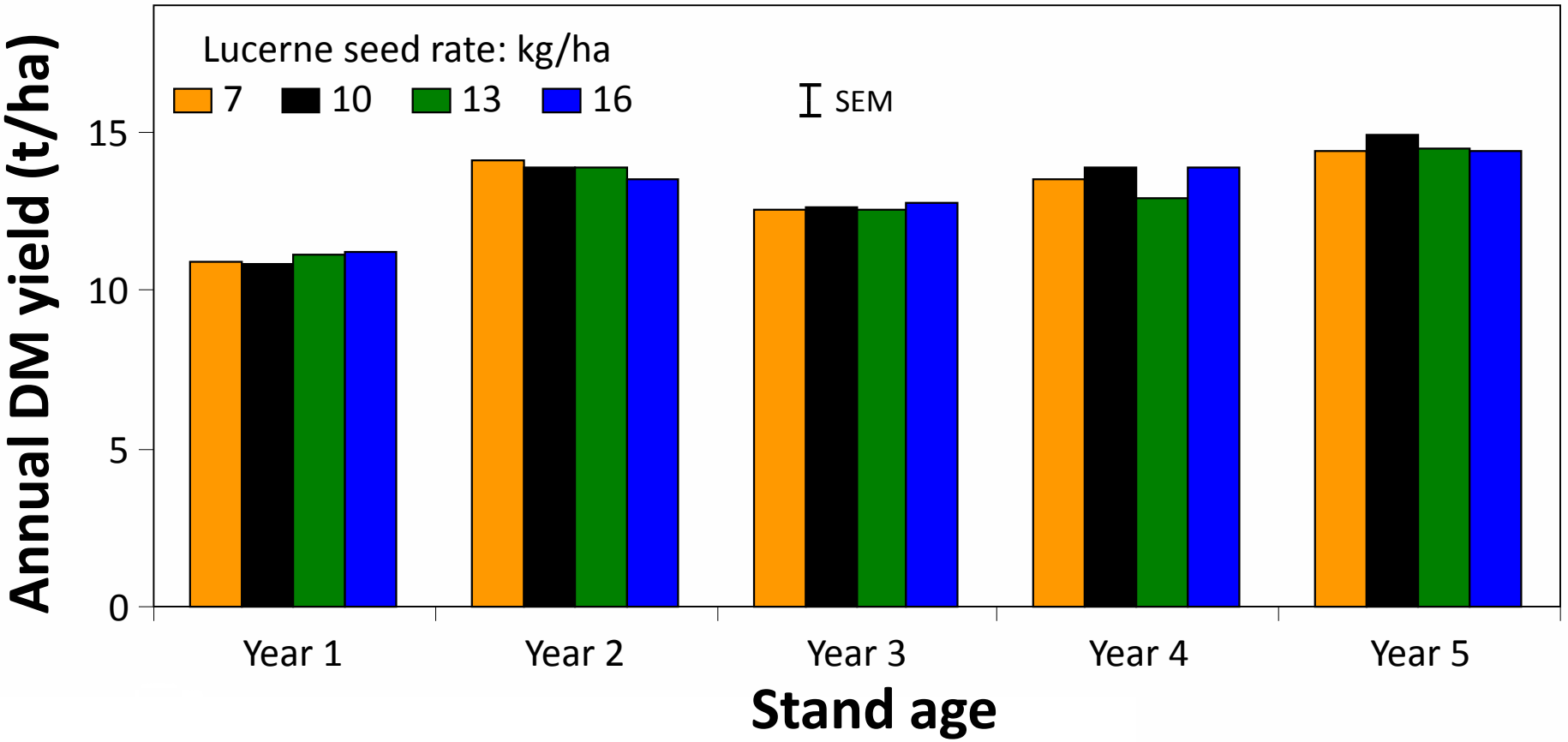
- Equivalent to bare seed @ 7, 10, 13 and 16 kg/ha

Sown seed & plant population over time



Moot *et al*. 2012

Annual yield in relation to sowing rate



Moot *et al*. 2012

Weed control

- Ensure adequate control of perennial weeds before sowing lucerne
- Triflurilan pre sowing – note dry conditions
- Spinnaker and 2,4 DB post emergence - or graze at 15 cm if weeds are an issues.
- Fathen only lasts one year.
- Minimal winter weed control in Year 0.

Sown: February October

Sampled: June

Photo: E.I. Teixeira
Lincoln University

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH·NEW ZEALAND

Taproot mass

Establishment

- Pre sowing – fertility and weed control pre sowing
- Firm seed bed for accurate seed depth (1 cm)
- Spring sow – October
- First crop cut – December
- Graze earlier if weedy - then flowering
- Start rotational grazing in January 15-30 cm
- Don’t need 10% flowering

- **Be patient!**

Growth:

is dry matter accumulation as a result of light interception and photosynthesis

Development:

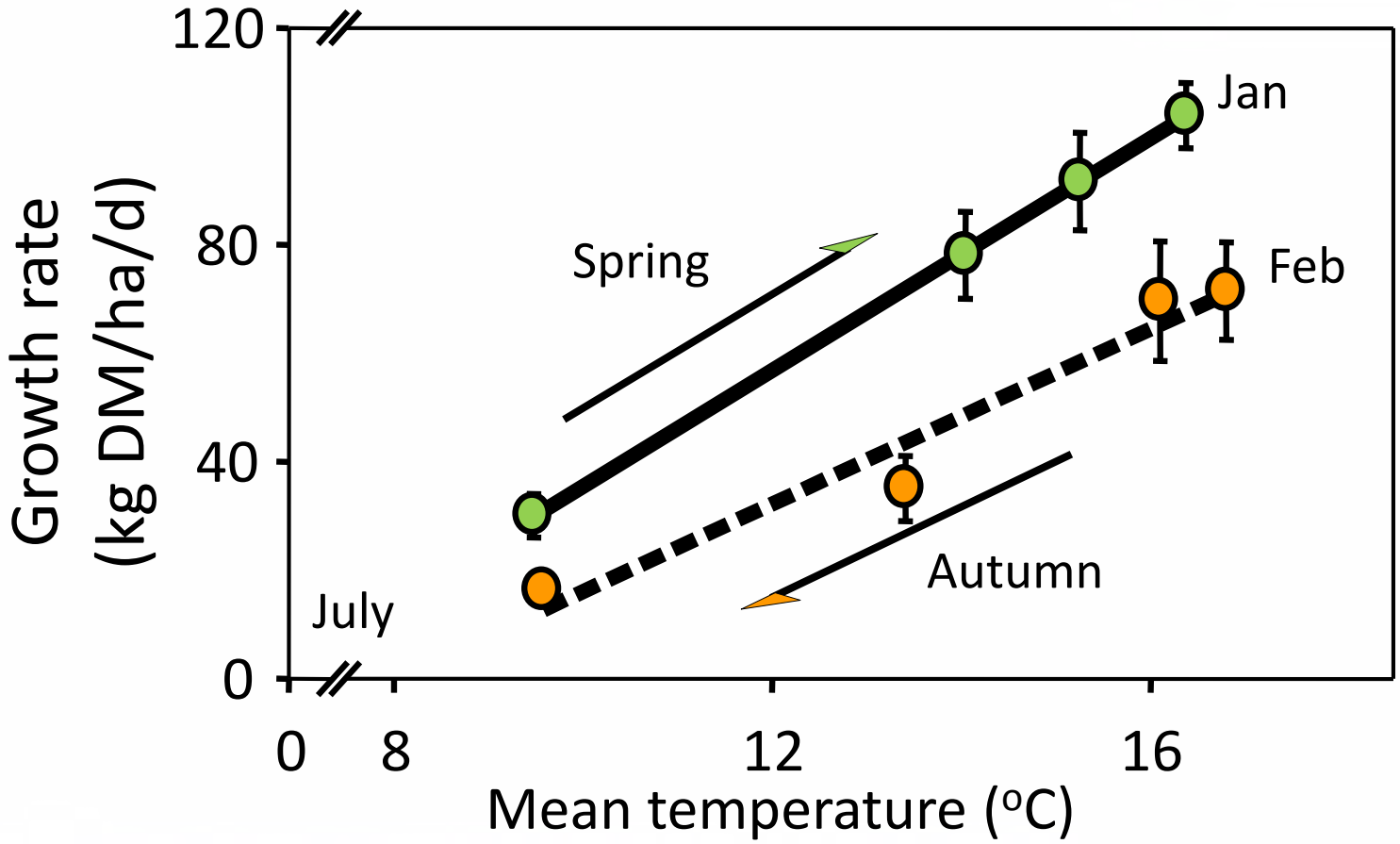
is the ‘age’ or maturity of the regrowth crop
e.g. leaf appearance, flowering

Growth and development are both influenced by environmental signals

The canopy:
the energy capture device

Photo: DJ Moot
Lincoln University

Vegetative growth



Moot *et al*. 2003

Experiment 2 flexible grazing

38 days resting

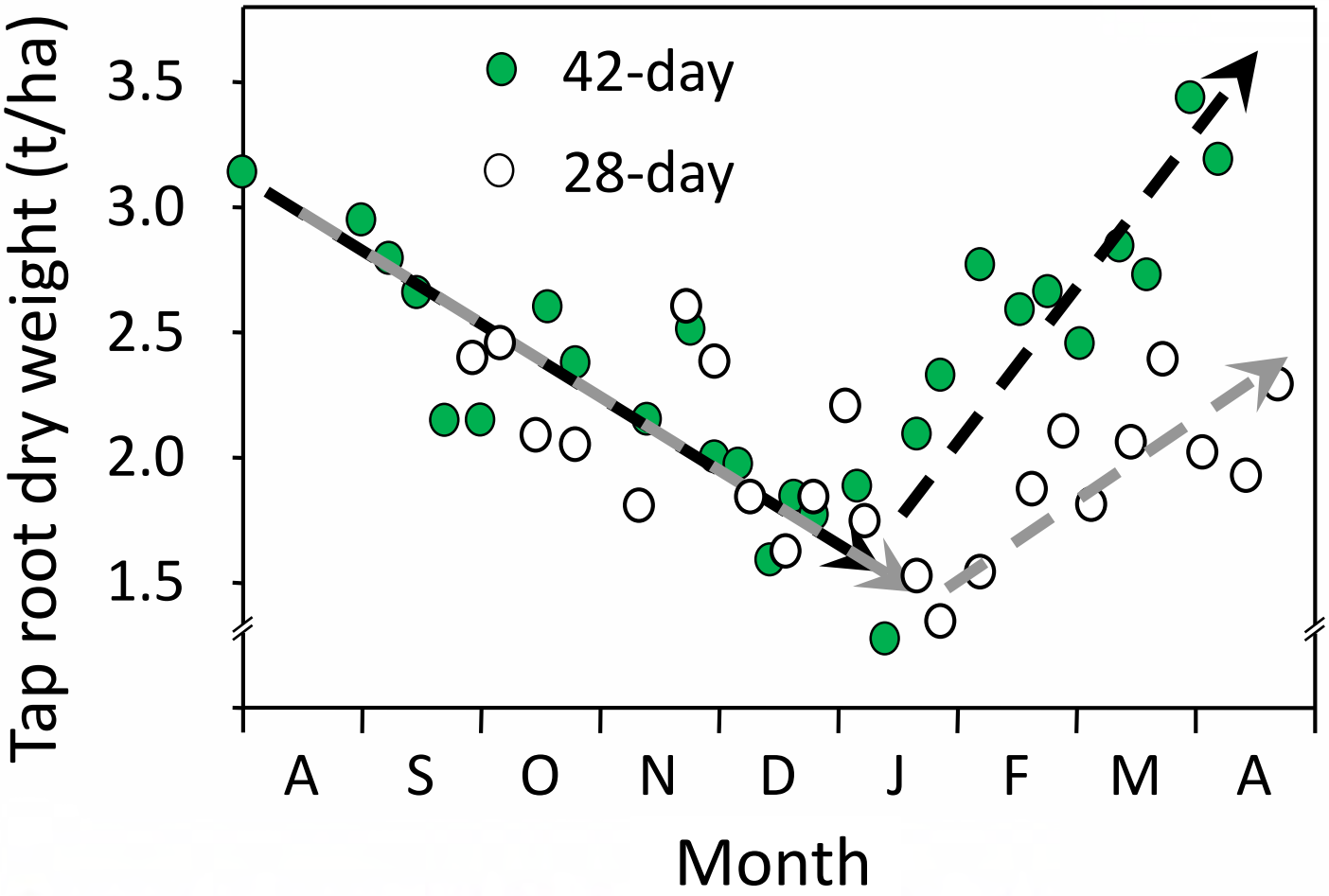
4 days grazing

25 days resting

3 days grazing

Photo: E.I. Teixeira
Lincoln University

Partitioning to roots



Moot *et al*. 2003

Seasonal grazing management

Spring

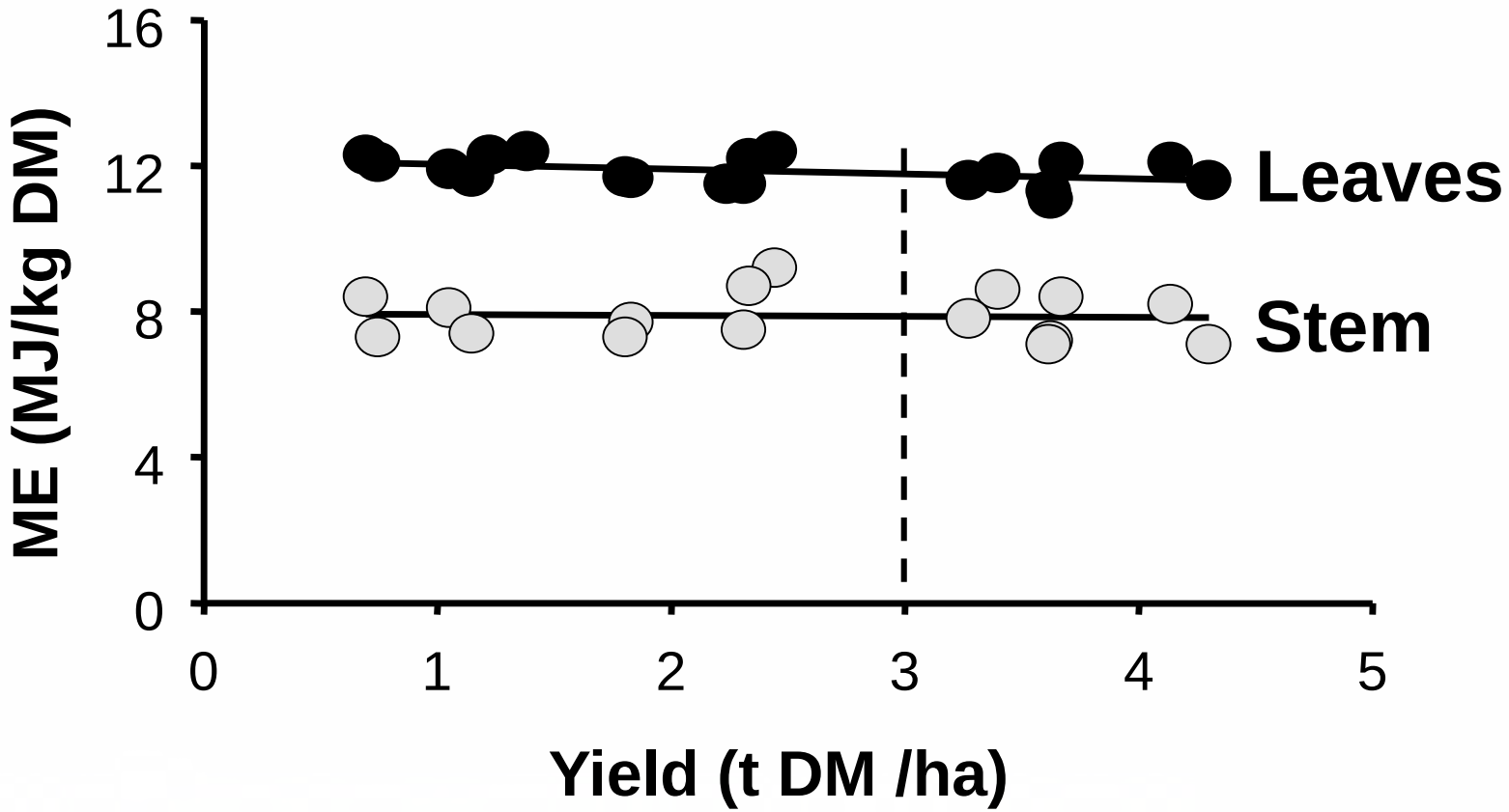
- 1st rotation aided by root reserves to produce high quality vegetative forage.

- can graze before flowers appear (~1500 kg DM/ha) ideally ewes and lambs but

Growing point at the top of the plant

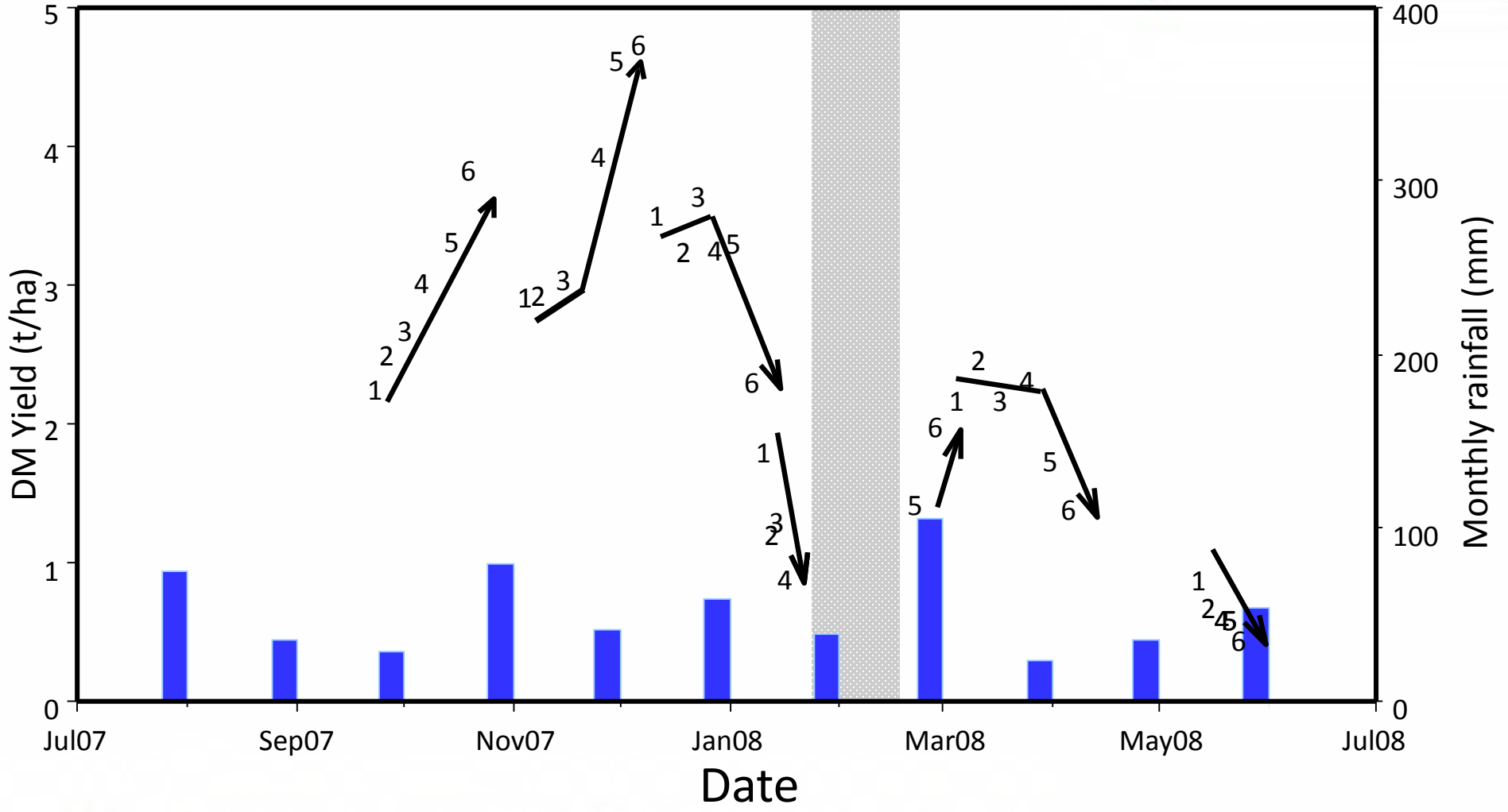
Rotation 1 Pre-graze
Plot 1 (21/9/07)
2.3 t DM/ha
20-25 cm tall

Metabolisable energy of lucerne



Brown & Moot 2004

MaxClover – 38-42 day rotation



Moot & Smith 2011

5th September 2011 – Cave, South Canterbury

Photo: DJ Moot
Lincoln University

Photo: H.E. Brown
Lincoln University

Photo: H.E. Brown
Lincoln University

Photo: H.E. Brown
Lincoln University

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND

Photo: H.E. Brown
Lincoln University

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH·NEW ZEALAND

Photo: Bonavaree, Marlborough

Spring grazing

Seasonal grazing management

Spring/summer (Nov-Jan)

- Priority is stock production (lamb/beef/deer)
- Graze 6-8 weeks solely on lucerne
- 5-6 paddock rotation stocked with one class of stock (7-10 days on)
- Allowance 2.5-4 kg DM/hd/d – increase later in season

High numbers for 7-10 days

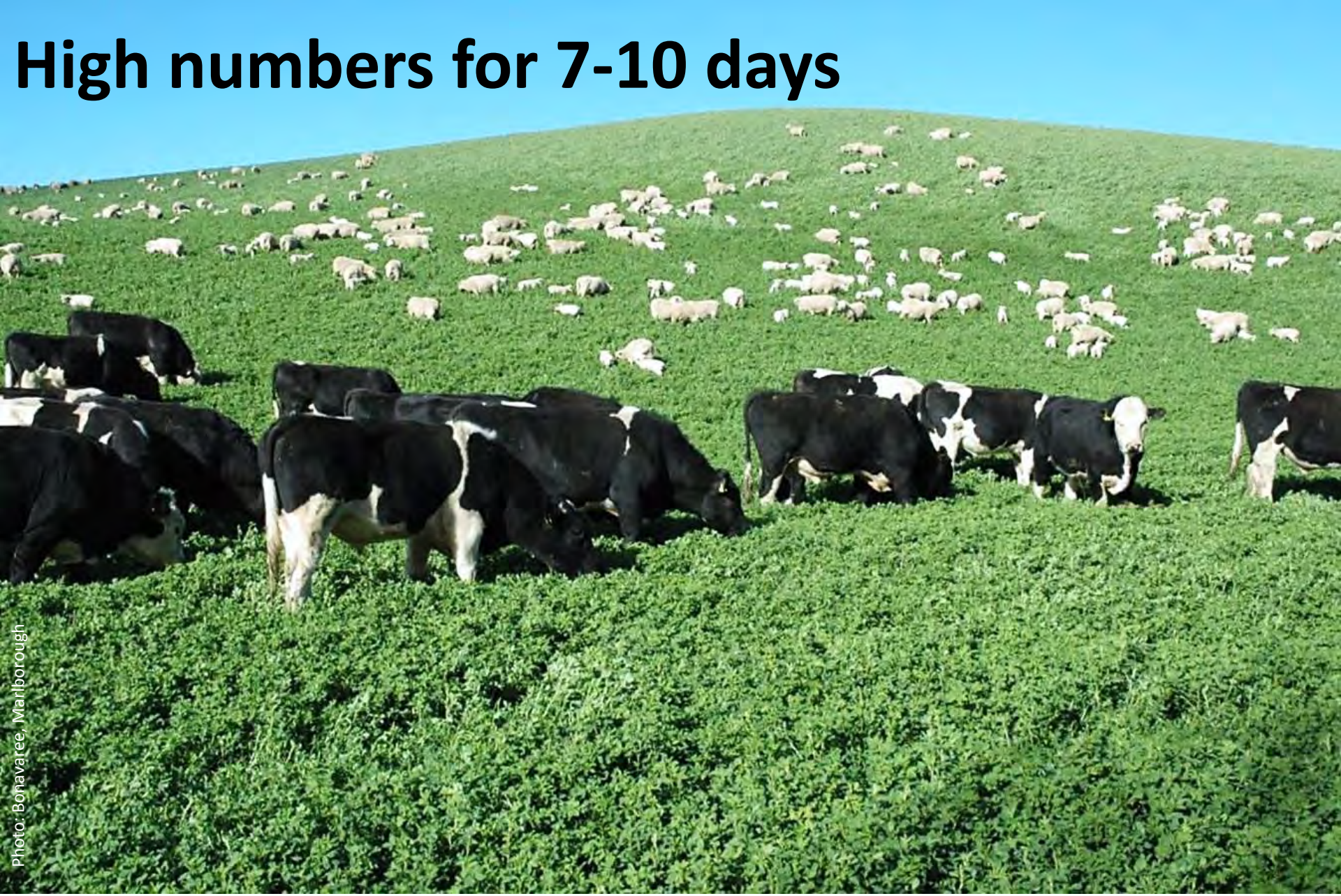


Photo: Bonavaree, Marlborough

Fibre and salt

Photo: Doug Avery, 'Bonavaree', Marlborough 6/10/2015

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH·NEW ZEALAND

Pre graze mow

Seasonal grazing management

Early autumn (Feb-April)

- terminal drought ⇒ graze standing herbage
- allow 50% flowering
- long rotation (42 days) somewhere between Jan and end of May.

⇒ build-up root reserves for spring growth and increase stand persistence

Autumn = flowering plants

Fertilizer

- Higher requirement from cutting than grazing
  - 2% K = 20 kg/ha/t DM removed

- 50% K super = 80 kg/ha/t DM removed

Or

- KCL = 40kg/ha/t DM removed + P and S from super

Photo: DJ Moot
Lincoln University

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND

Animal health

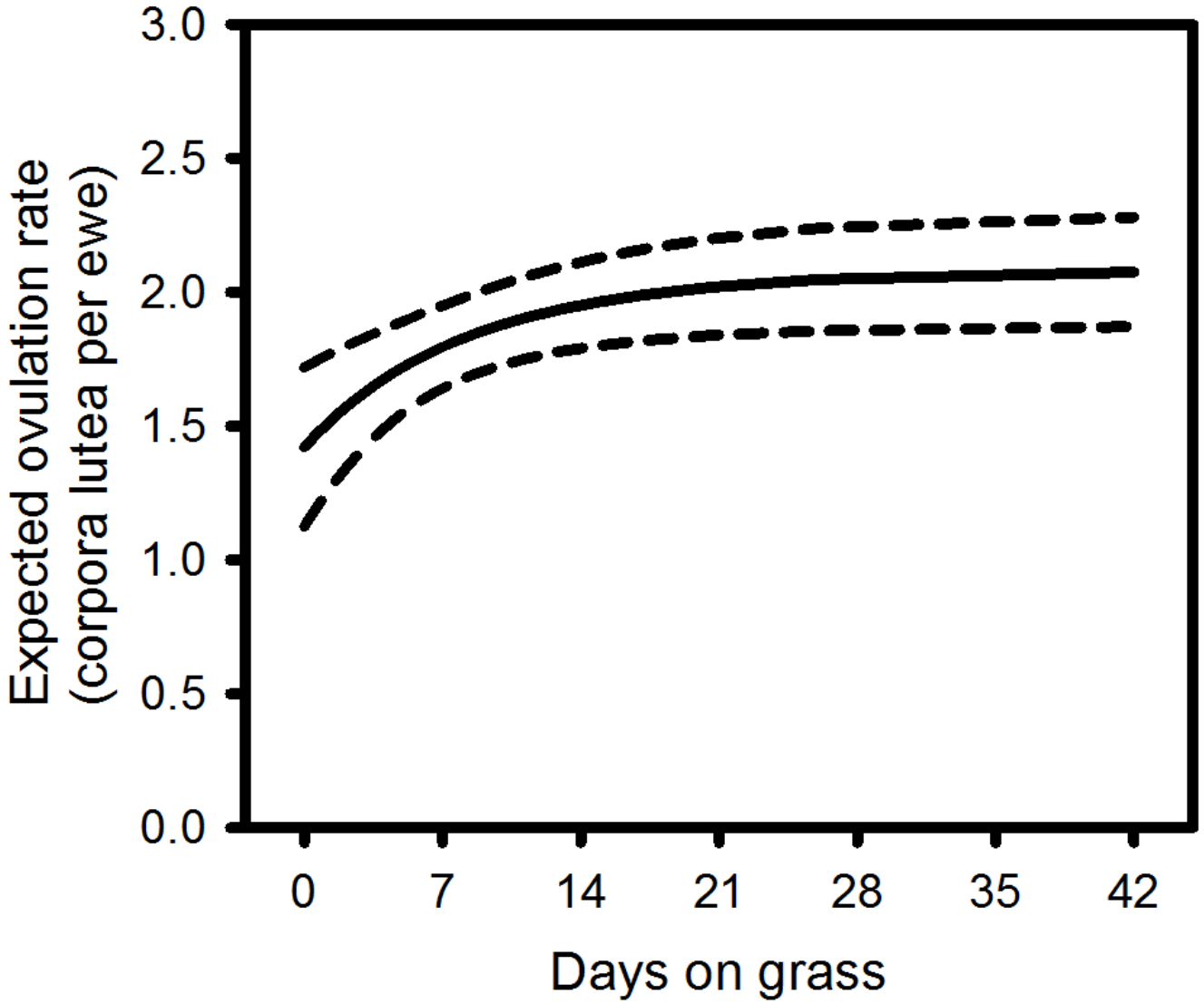
- **Clostridial bacteria:** vaccinate
- **Cobalt:** vitamin B12 injection
- **Worm haven:** Camping on small area – river edge?
- **Avoid flushing if:** leaf spots or dull weather

When is coumestrol high?

- Ranges from 0 to 600 mg/kg.
- **>25 mg/kg** sufficient to reduce ewe ovulation rate.
- Produced in response to fungal pathogens.

Fields *et al*. 2017

Two weeks off lucerne



Fields *et al*. 2017

Animal health

- **Redgut:** problem on high quality feeds – fibre
- **Bloat:** cattle more than sheep – capsules
- **Na def.** (0.03%): salt licks/fence-line weeds/pasture
- Require 0.11% Na - sheep/beef/dairy

Conclusions

- Start spring grazing at 10- 15 cm
- Ewes and lambs at about two weeks
- Quality maximized at 30 cm
- Leaf and soft stem are highest quality
- Ignore residual
- Drop out paddocks if recovery is rapid
- Allow a period of extended growth in autumn
- Wet autumn – flush on grass

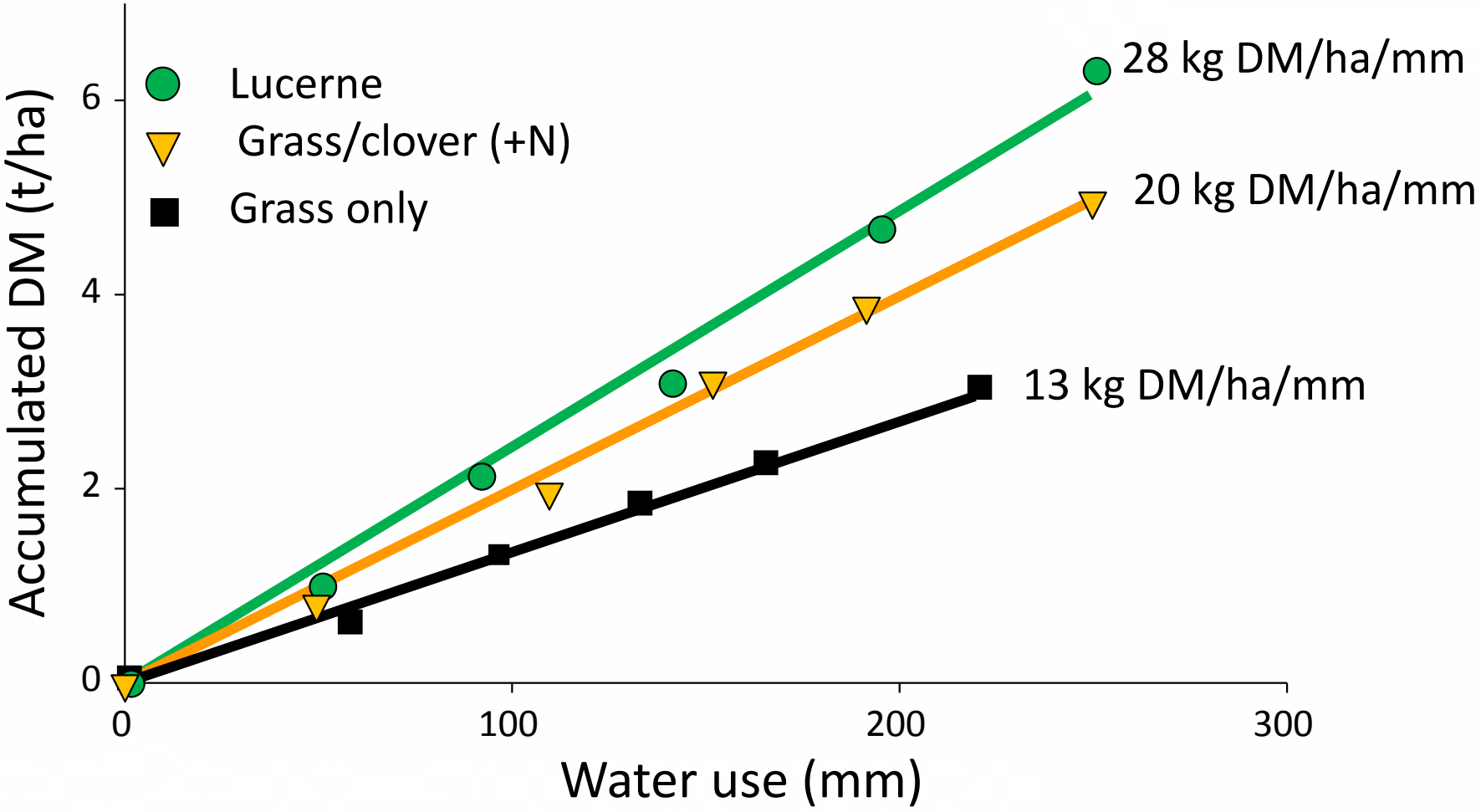
Case study – Bonavaree farm, Marlborough

Over grazed – high erosion risk

Financially – no return

Dryland lucerne conversion

Spring WUE



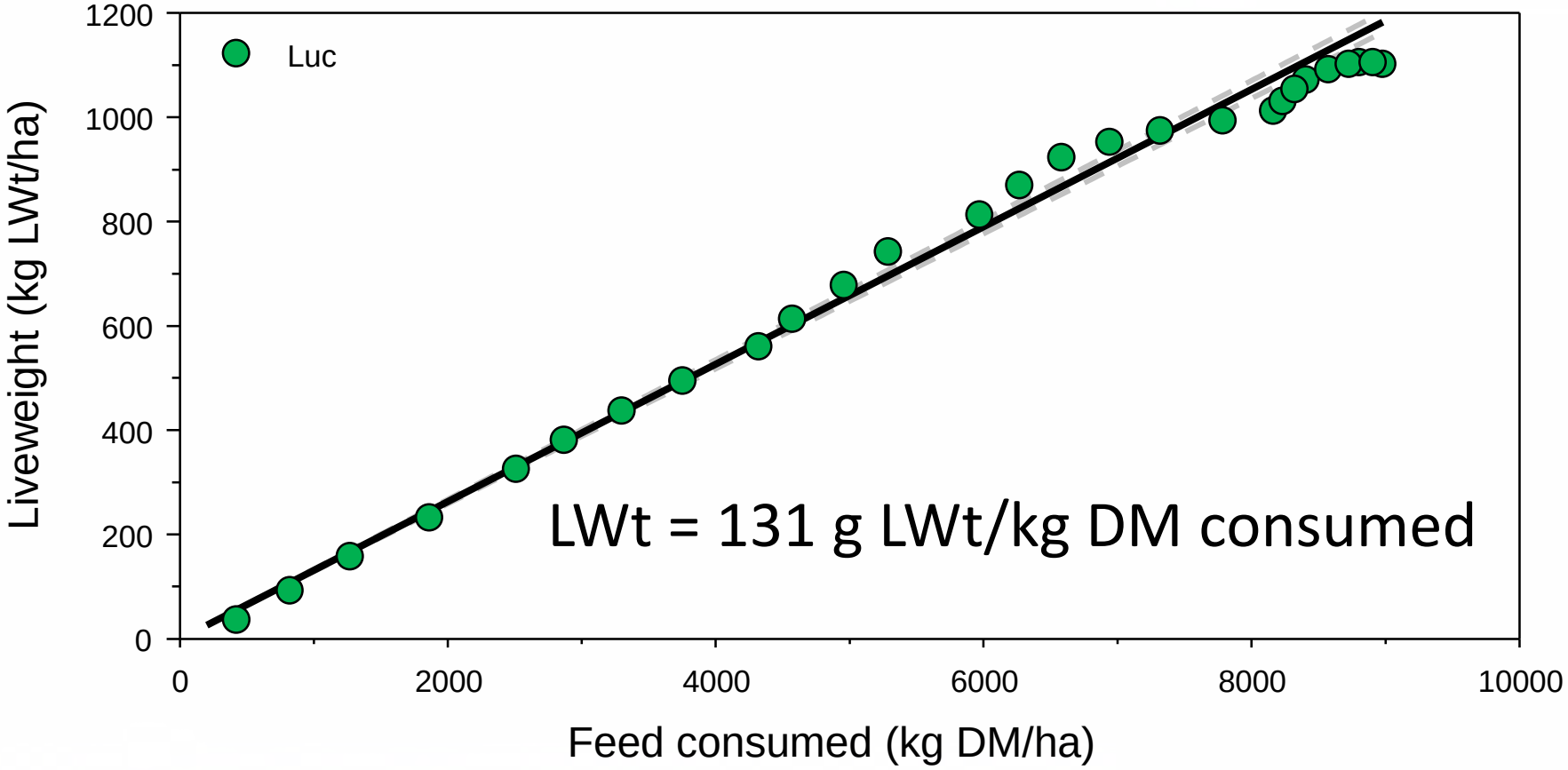
Moot *et al*. 2008

Bonavaree 14/8/2017

Photo: DJ Moot
Lincoln University

Photo: Doug Avery,
Bonavaree, Marlborough

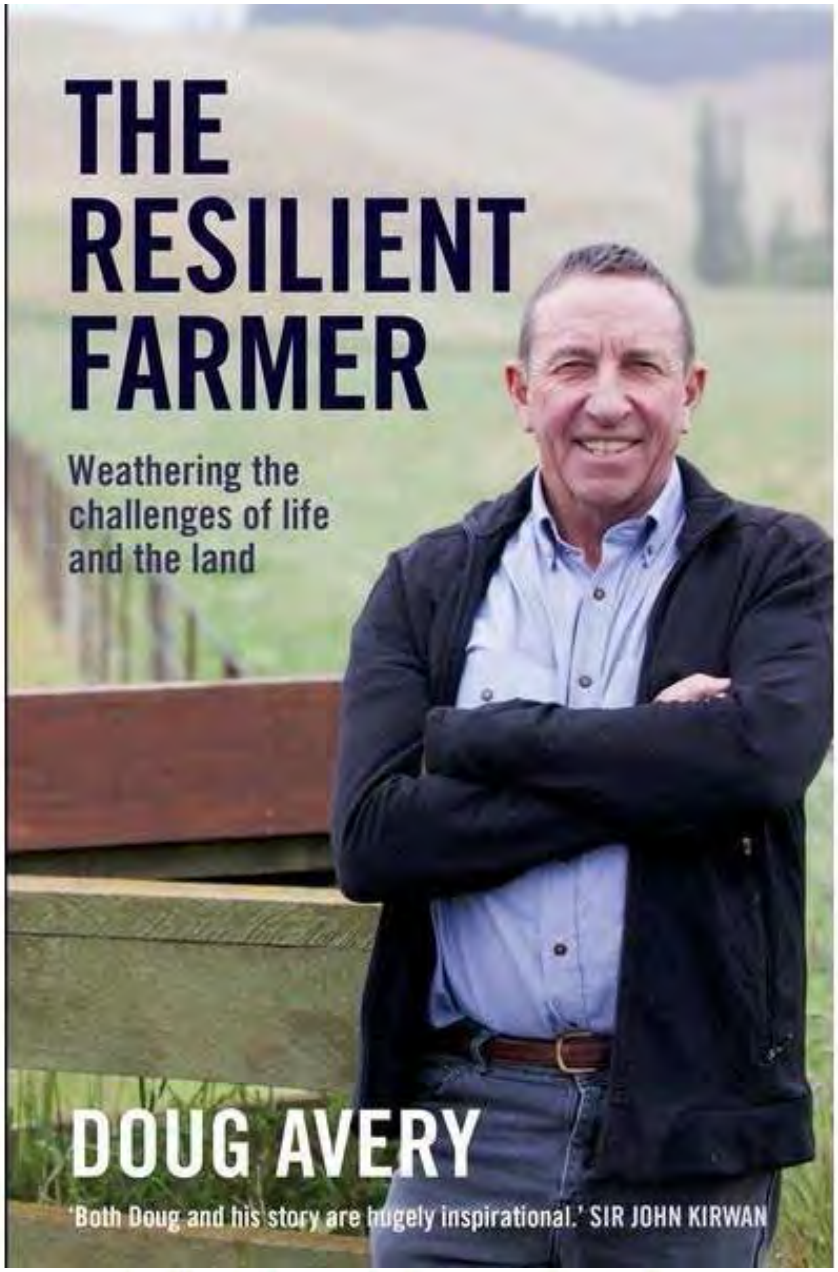
Relationship between LWt production and feed consumed



T Ryan-Salter unpublished

‘Bonavaree’ production change over 10 years

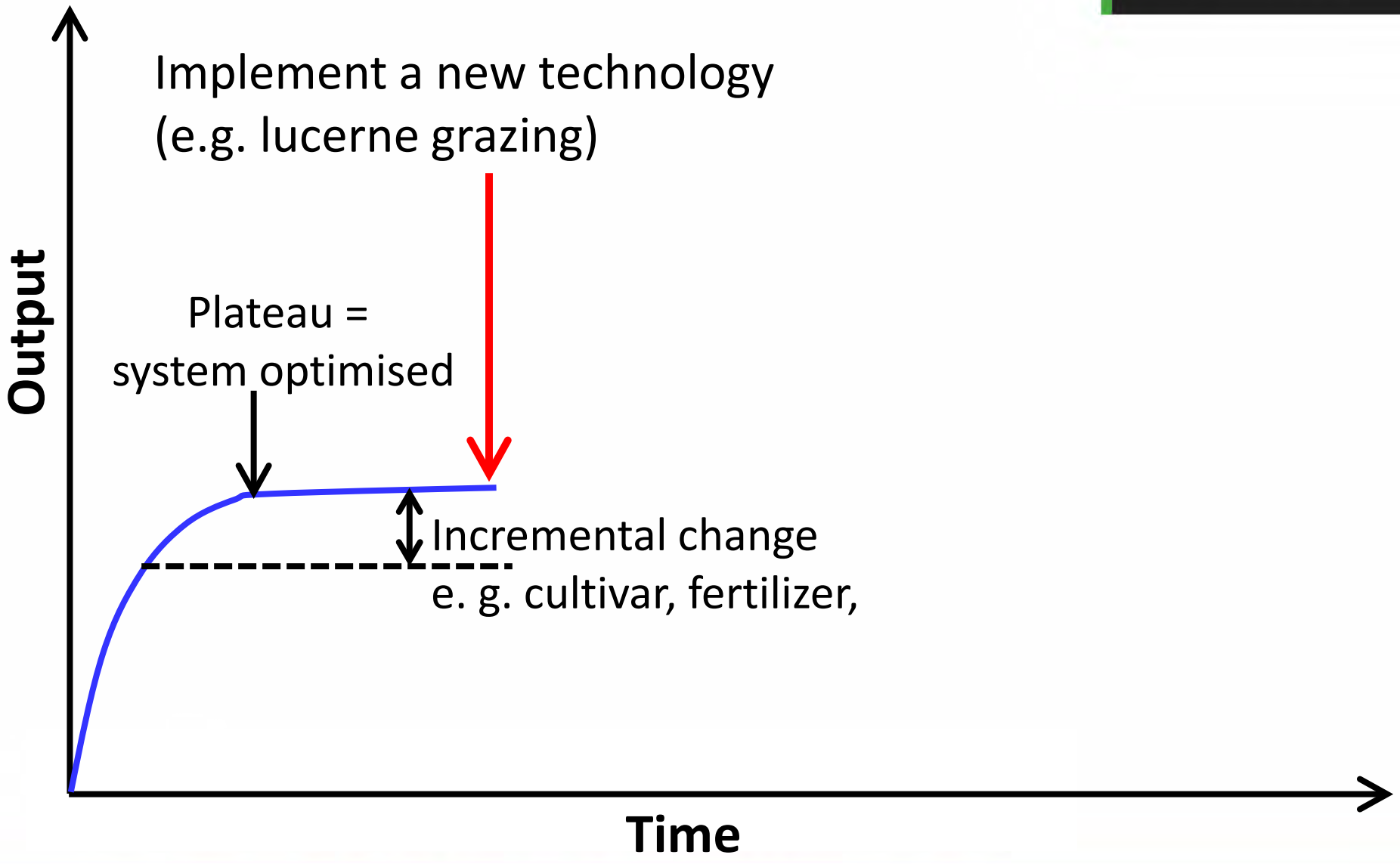
	2002	2012	Change
Land area (ha)	1100	1800	↑ 64%
Sheep numbers	3724	4158	↑ 12%
Lambing (%)	117	145	↑ 28%
Lamb weights (kg)	13.3	19	↑ 43%
Lamb sold (kg)	38324	74460	↑ 94%
Wool (kg)	18317	20869	↑ 14%
Sheep:cattle	70:30	50:50	
Gross trading profit (ha)	$317	$792	↑ 149%



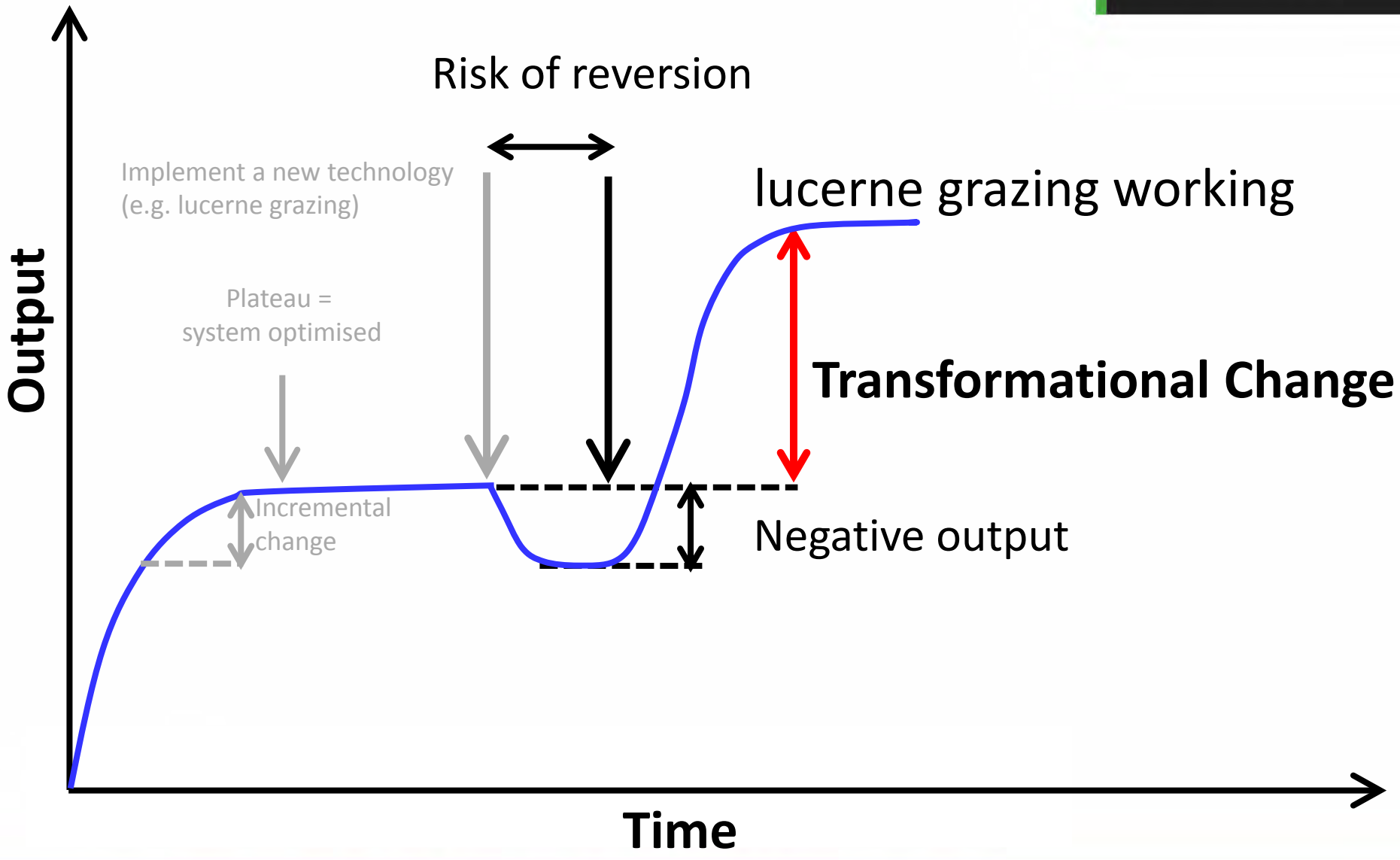
Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA · NEW ZEALAND

New Zealand's specialist land-based university

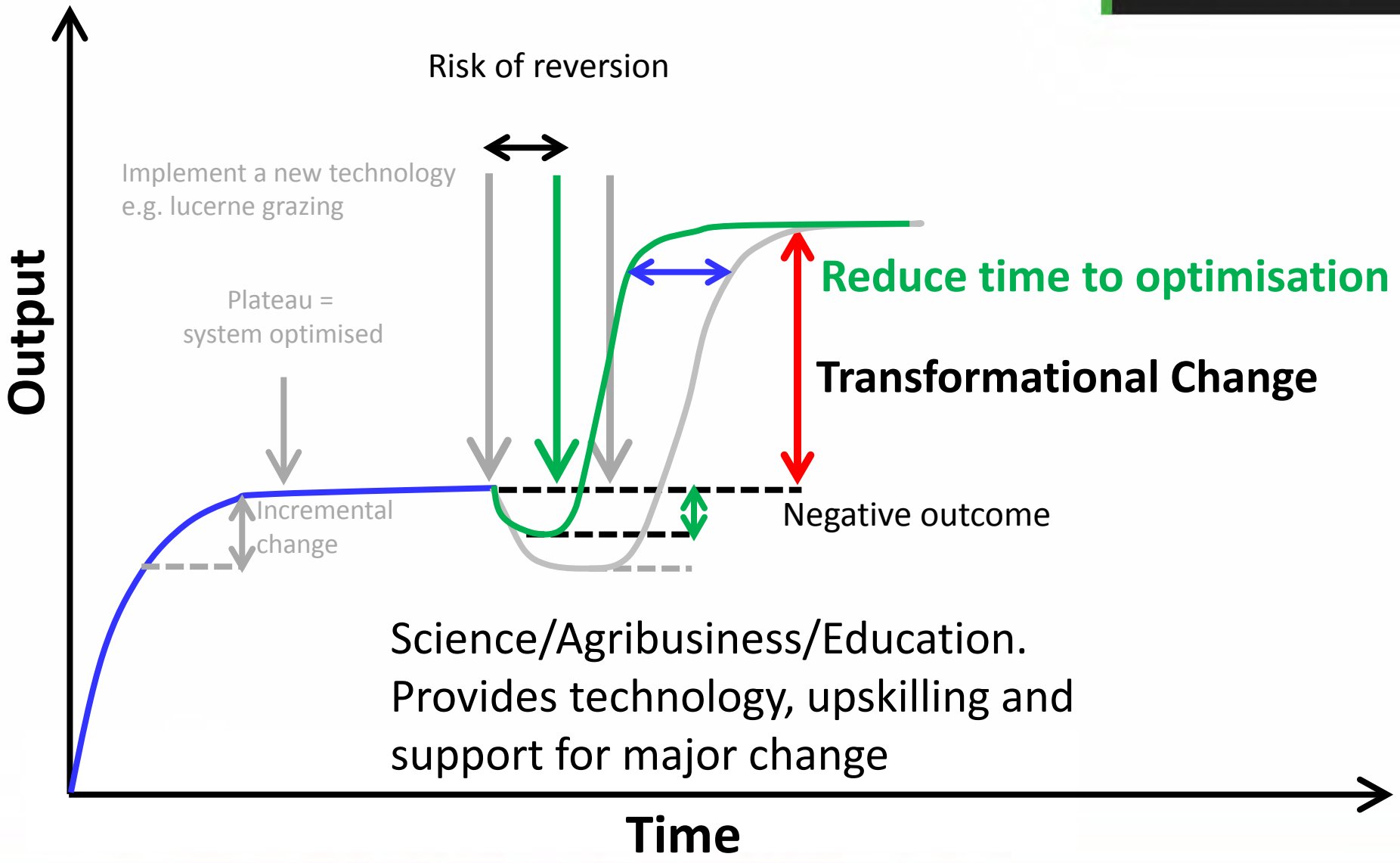
Pathway to change



Pathway of change

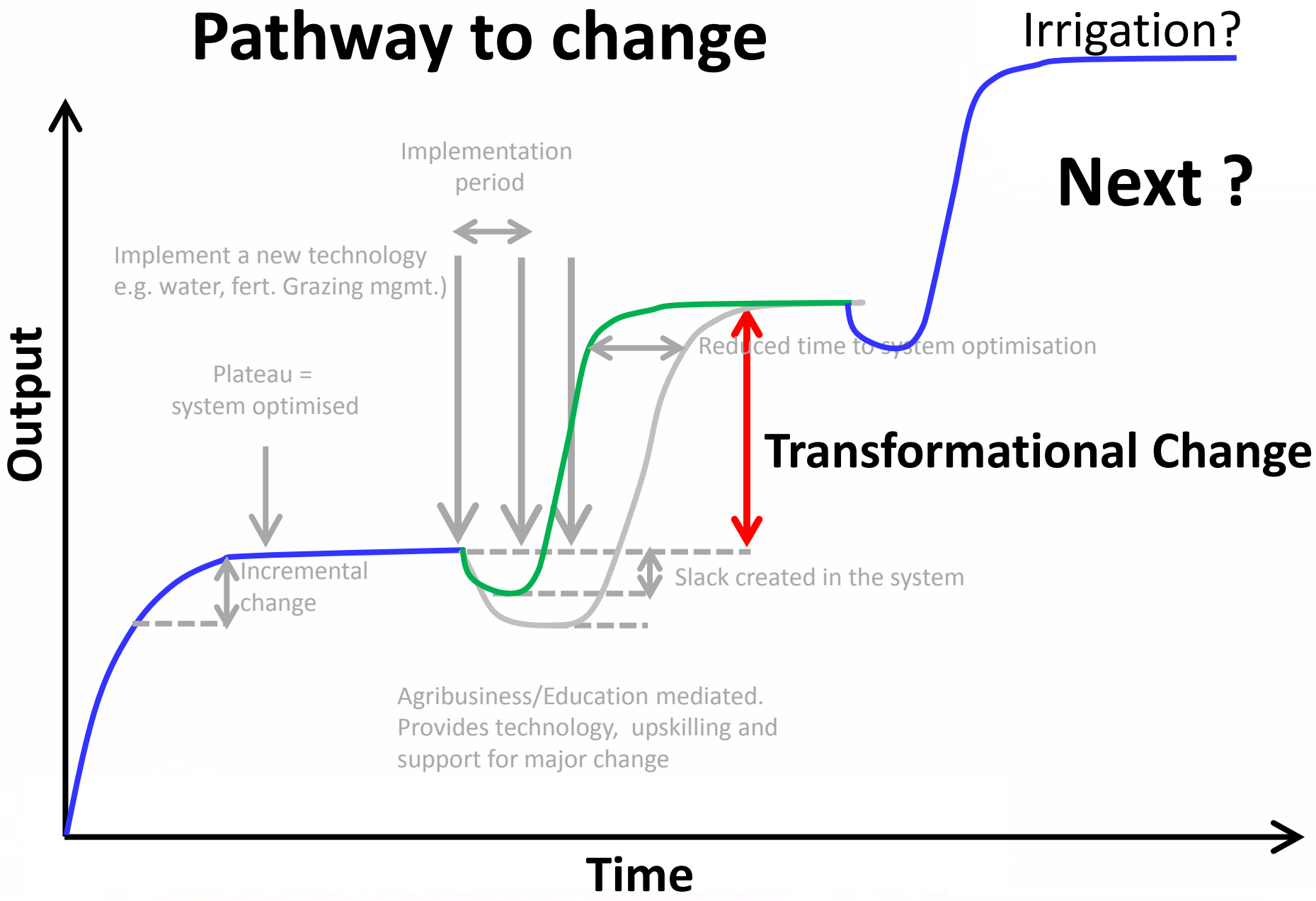


Pathway to change



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

Pathway to change



Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH • NEW ZEALAND

A story of change

Dave (Gundy) & Lisa Anderson

New Zealand's specialist land-based university

Moot et al. 2018

Old System

- Set-stocked
- Constant grass chasing
- Hill country in decline
- 100 day supplement winter feeding
- Peak feed demand and supply misaligned

Moot et al. 2018

Landscape farming – Bog Roy Station

Photo: DJ Woot
Lincoln University

Getting Started

Moot et al. 2018

Landscape farming

Moot et al. 2018

Measuring, Monitoring & Analysing

Moot et al. 2018

Ewe flock performance

kg lamb weaned = number of lambs x weaning weight

Key Drivers are:

Ewe Performance

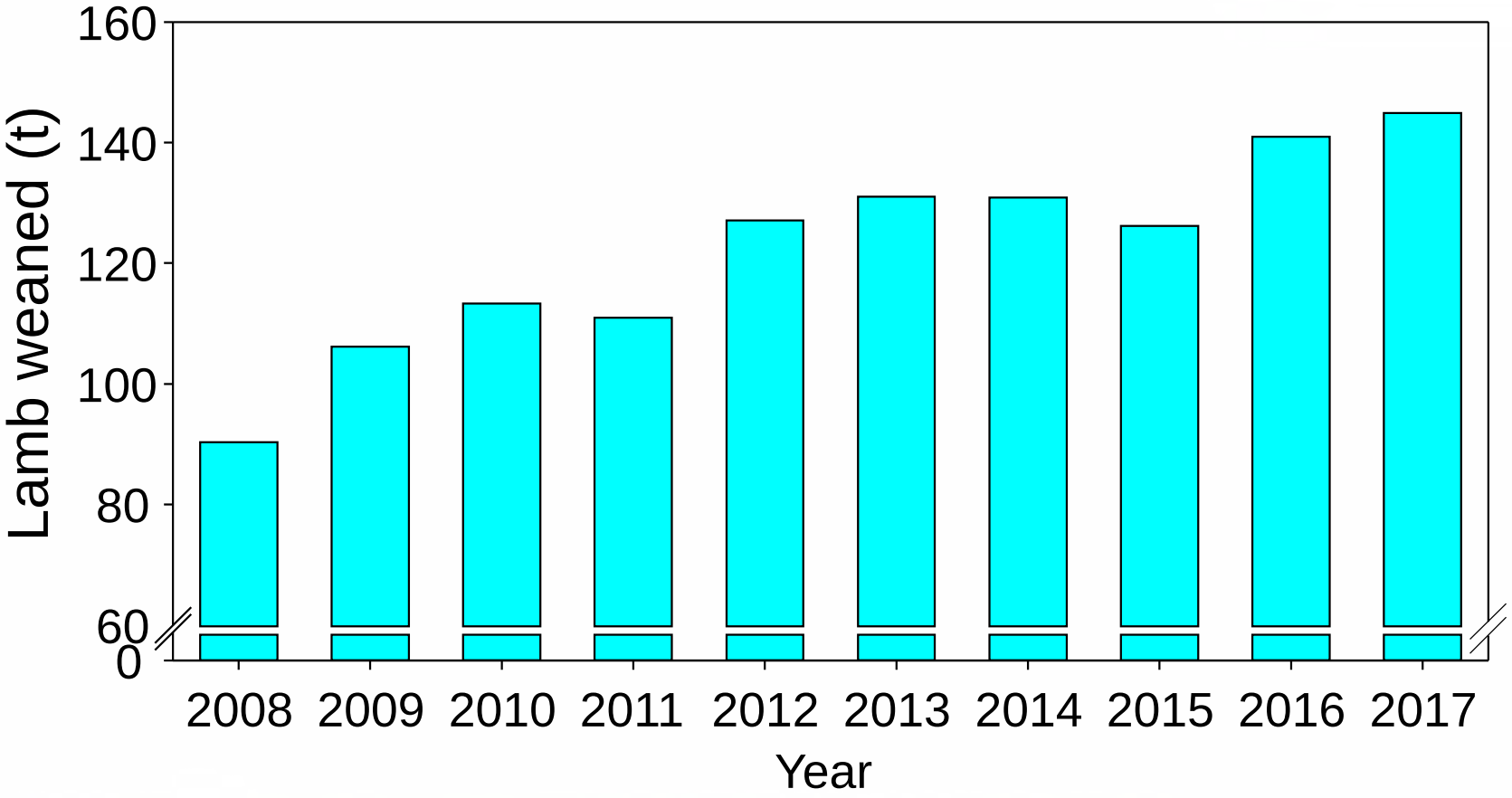
- Scanning %
- Lamb wastage %
- Lambing %

Lamb Performance

- Lamb growth rate
- Lamb weaning weight

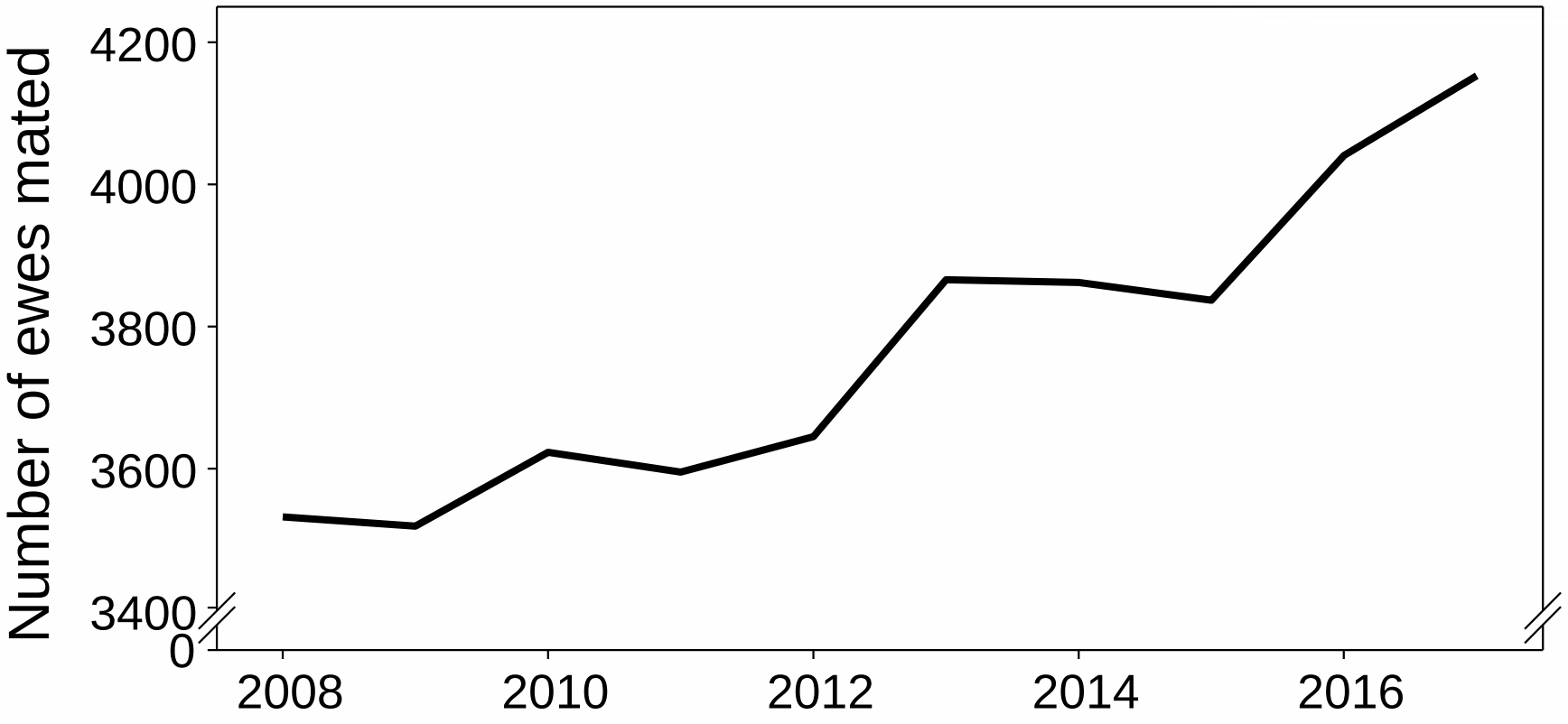
Moot et al. 2018

Change in LWt produced at Bog Roy



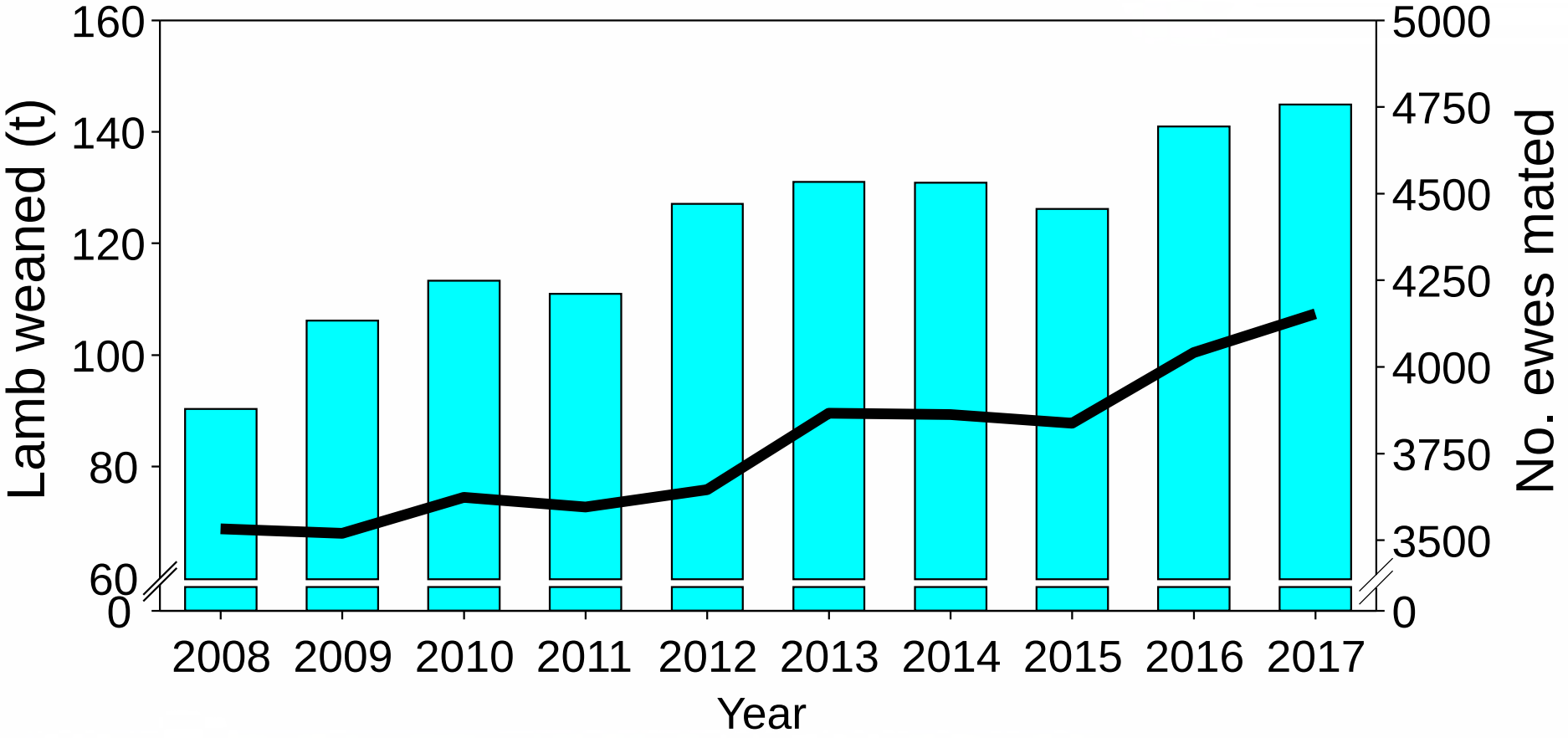
Moot *et al.* 2018

Change in ewes mated at Bog Roy



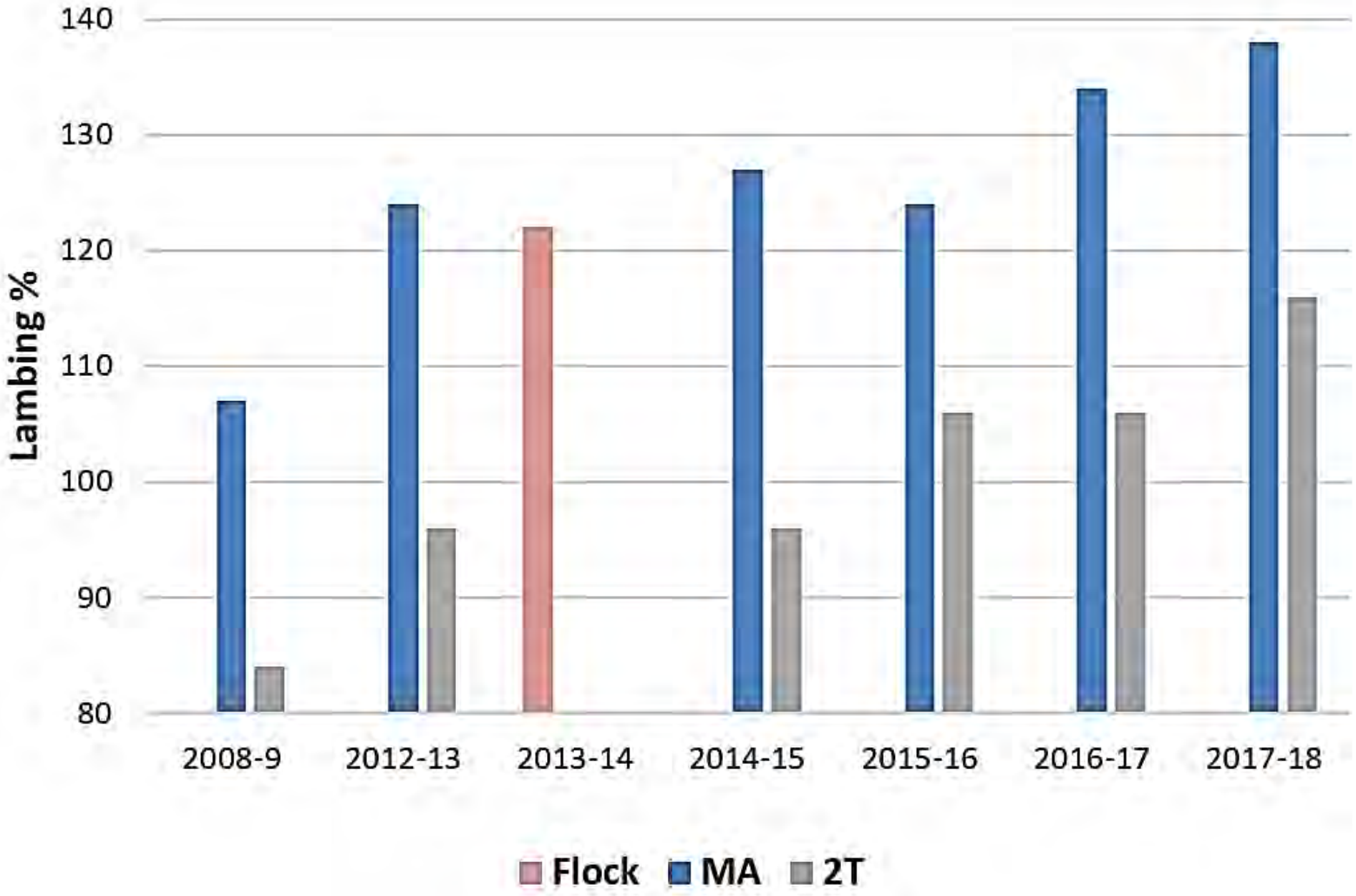
Moot et al. 2018

Change in LWt produced at Bog Roy



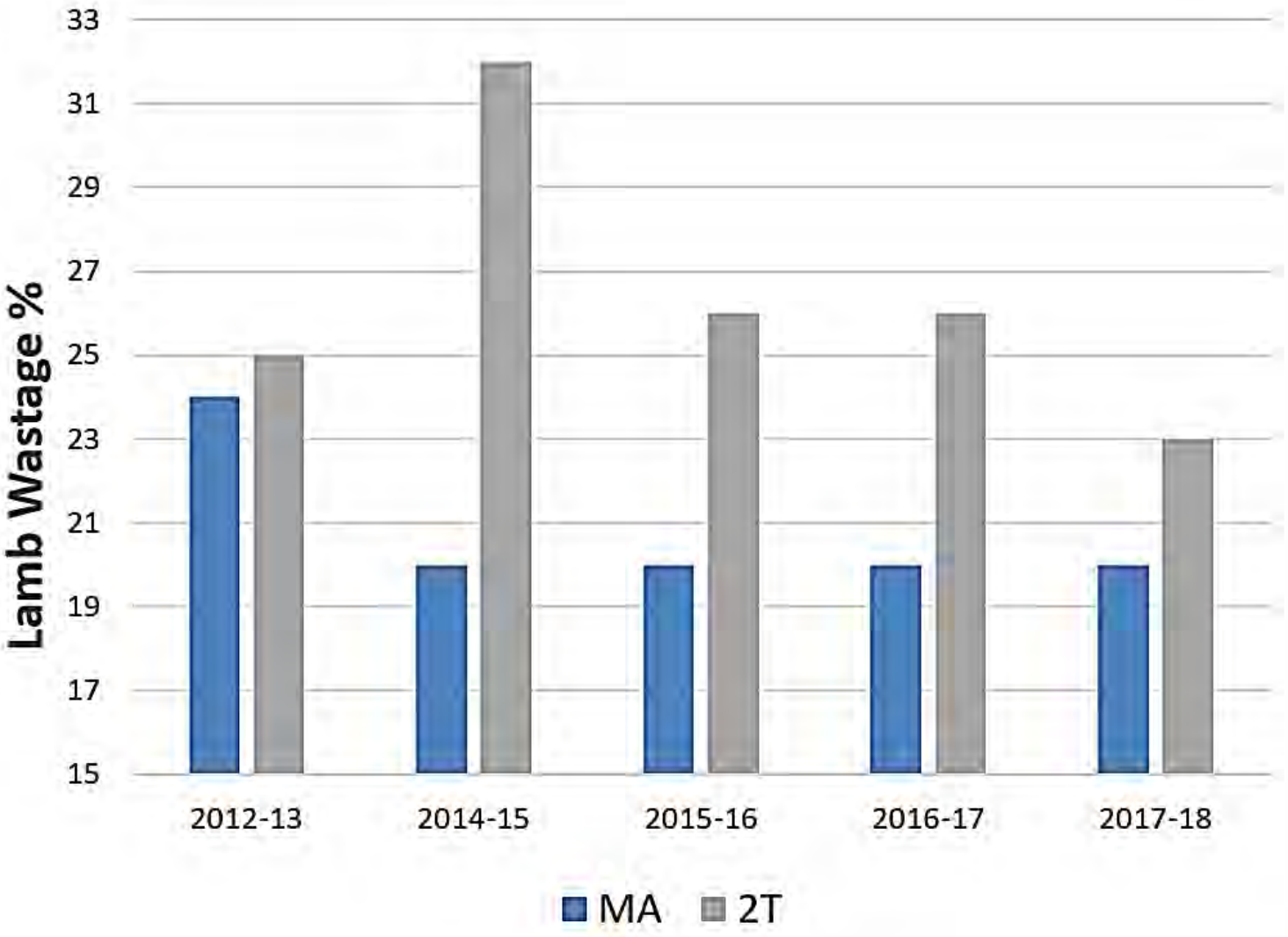
Moot et al. 2018

MA + 2T Lambing %



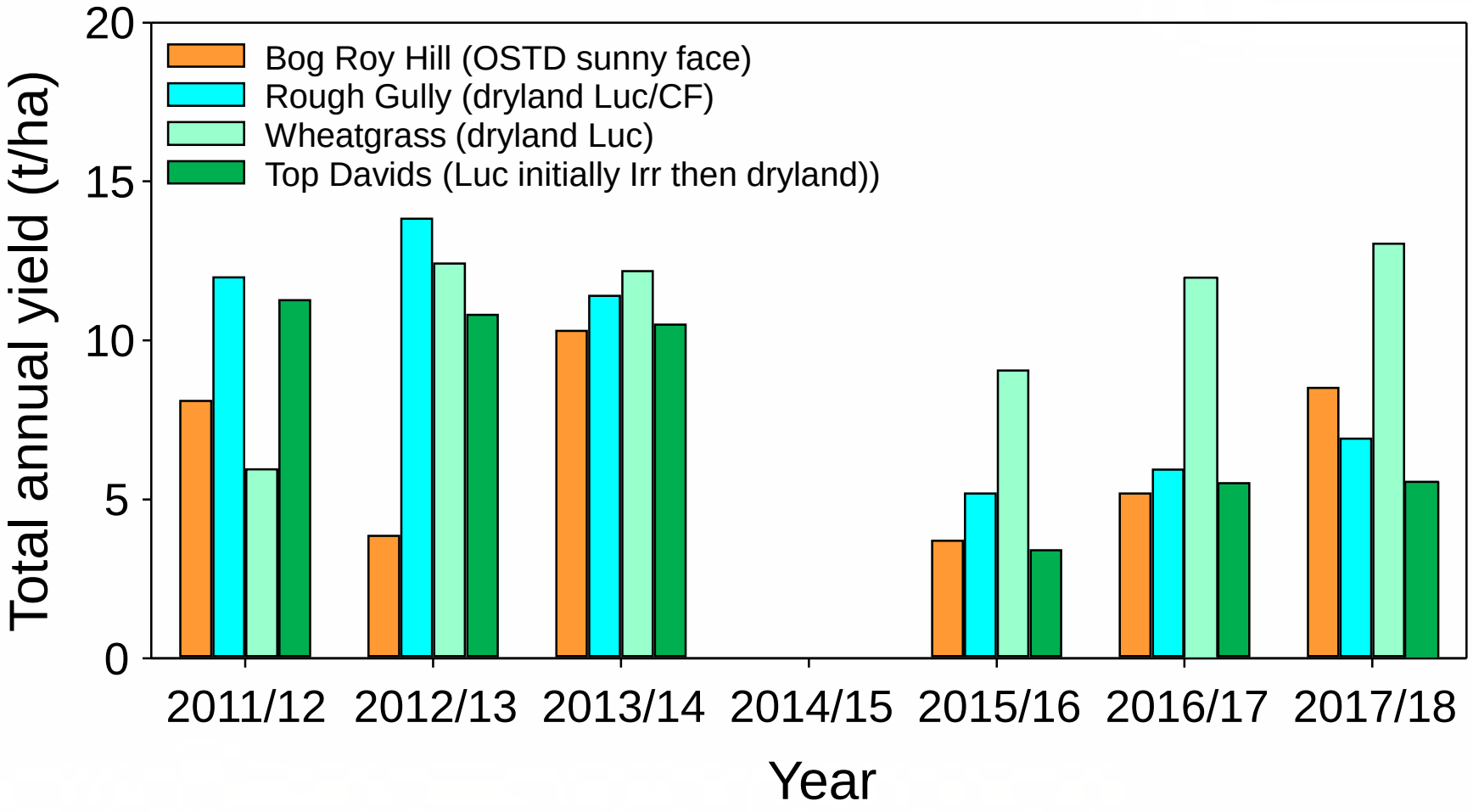
Moot et al. 2018

MA + 2T Lamb Wastage %



Moot et al. 2018

Total Annual DM yields – Bog Roy

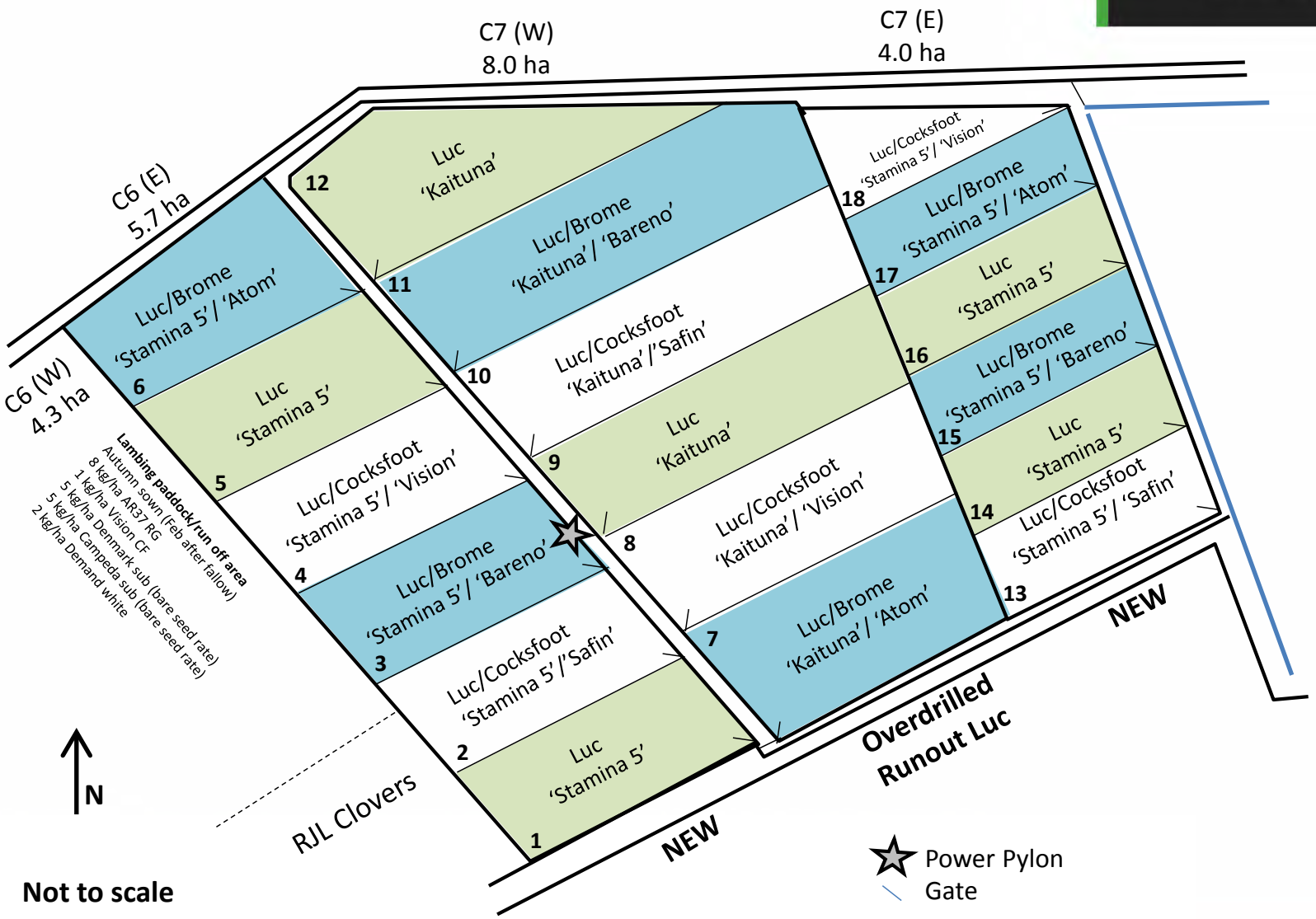


Transformational change at Bog Roy

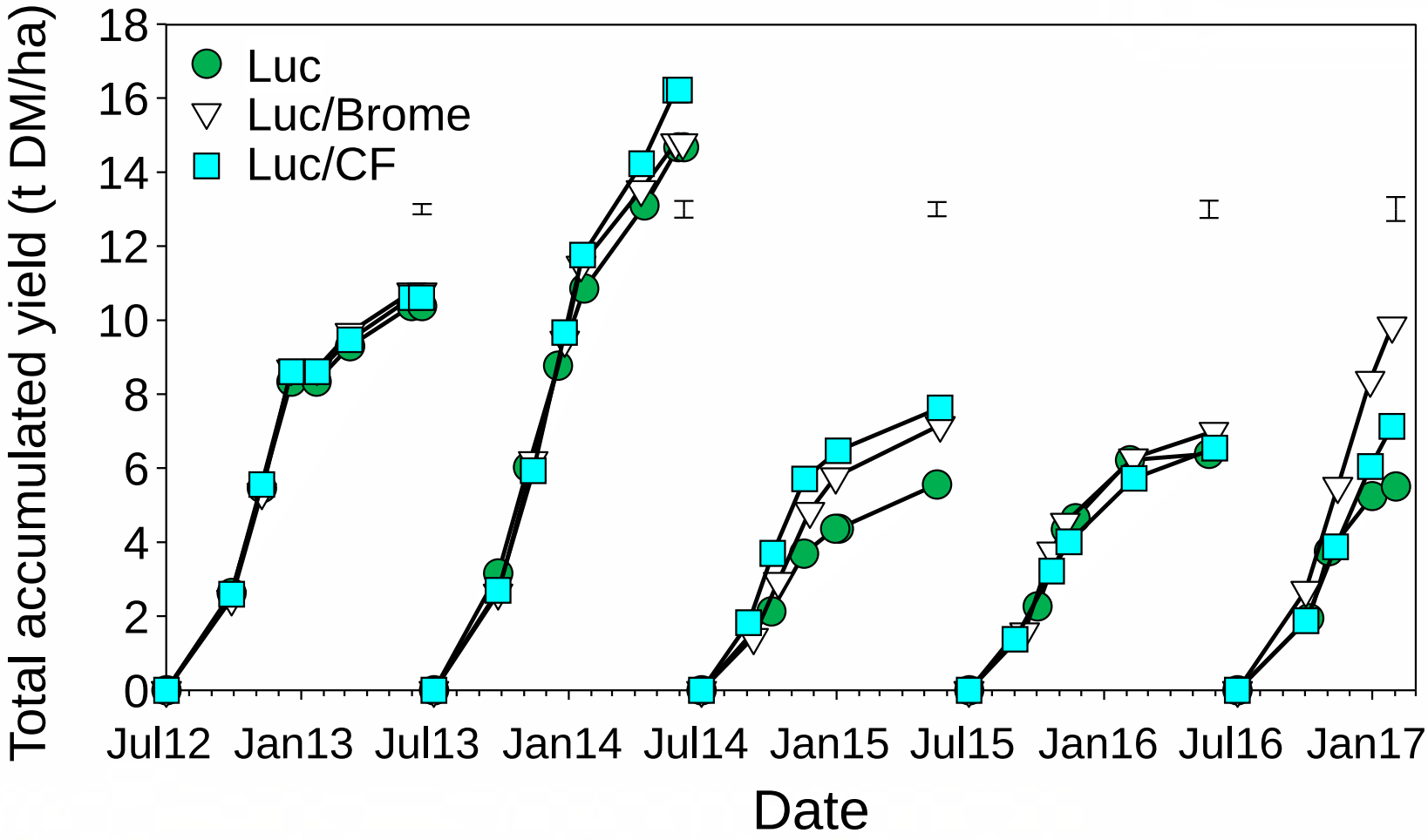
- Change to lucerne grazing priority
- Increased per head performance of ewes
- Increased dry matter grown with new lucerne
- Less winter feed made
- Weaned lambs sold at heavier weights
- Complicated by water/tenure review/succession

“We listened to advice and acted on it”

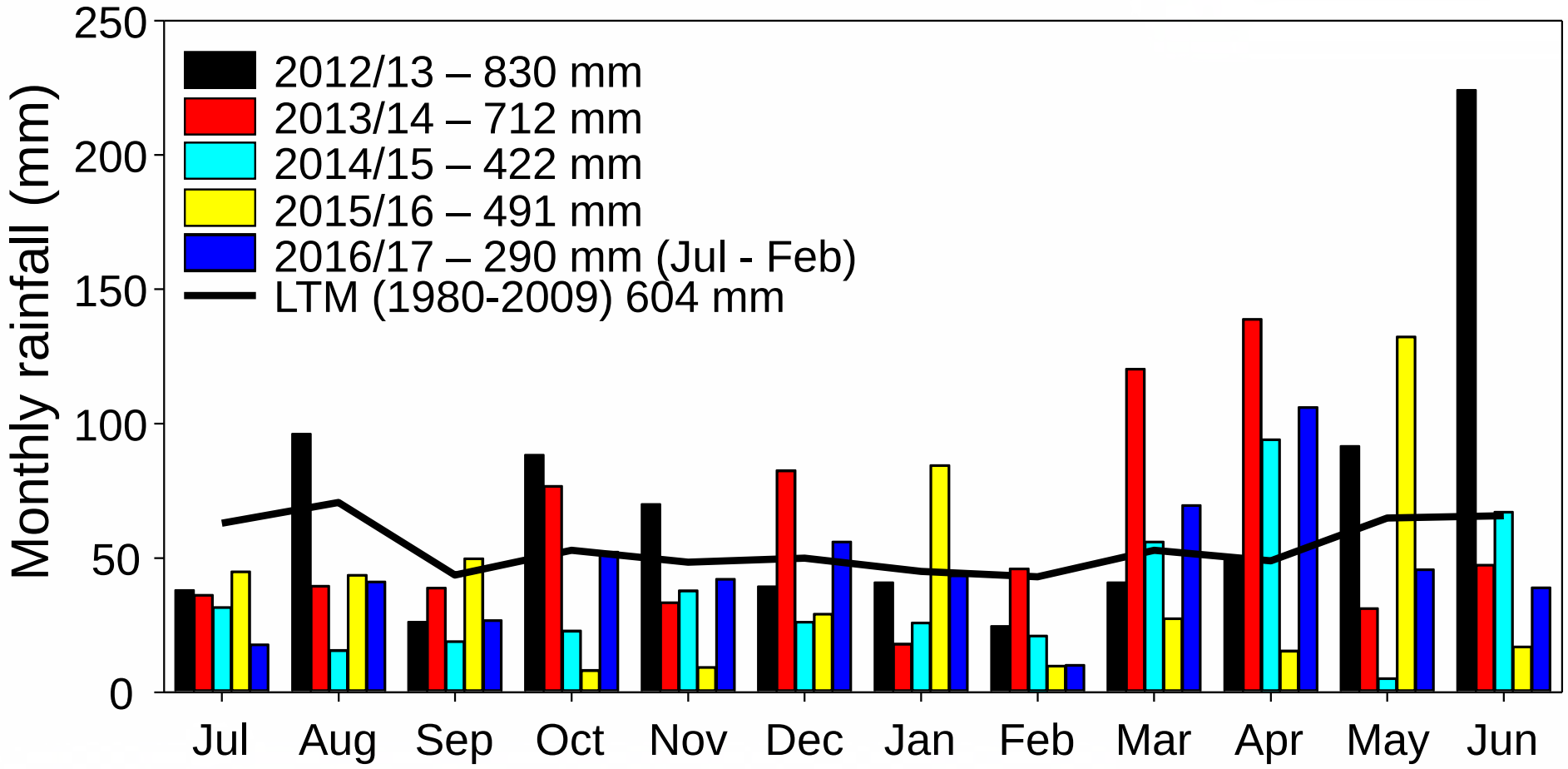
MaxLucerne – Ashley Dene



MaxLucerne – Ashley Dene Accumulated DM production

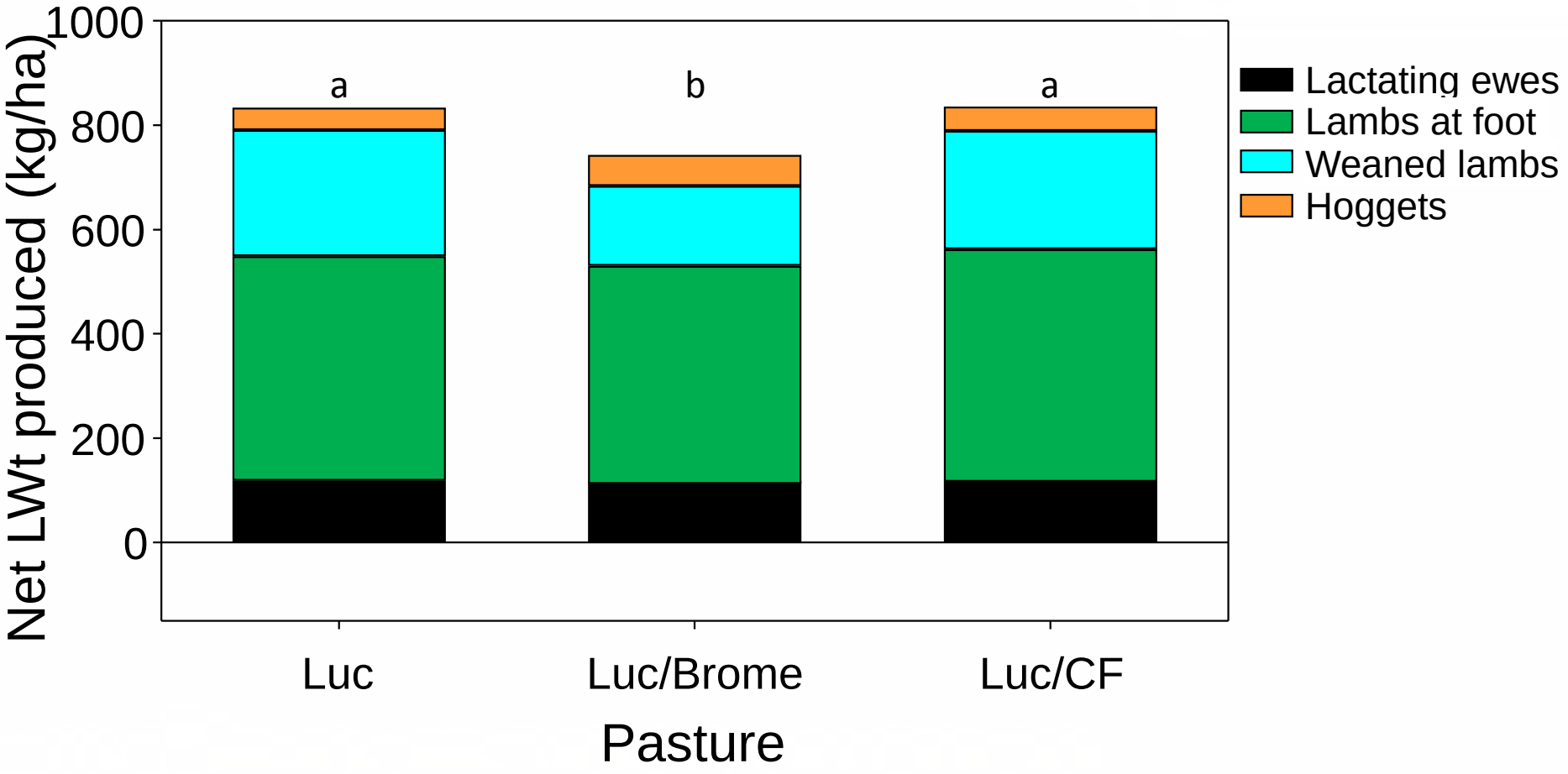


Rainfall at Ashley Dene



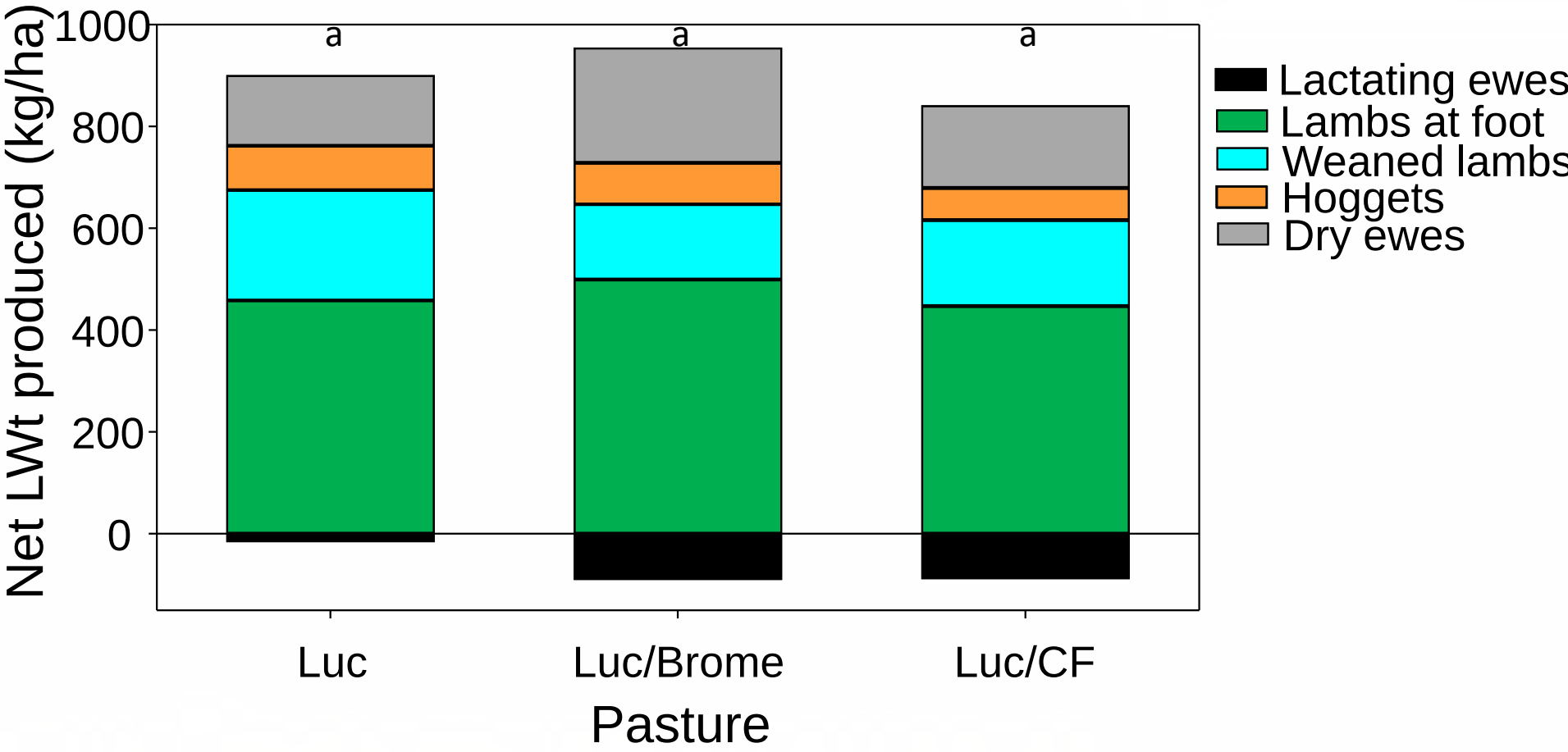
MaxLucerne – Ashley Dene

Net LWt Production by class 2012/13



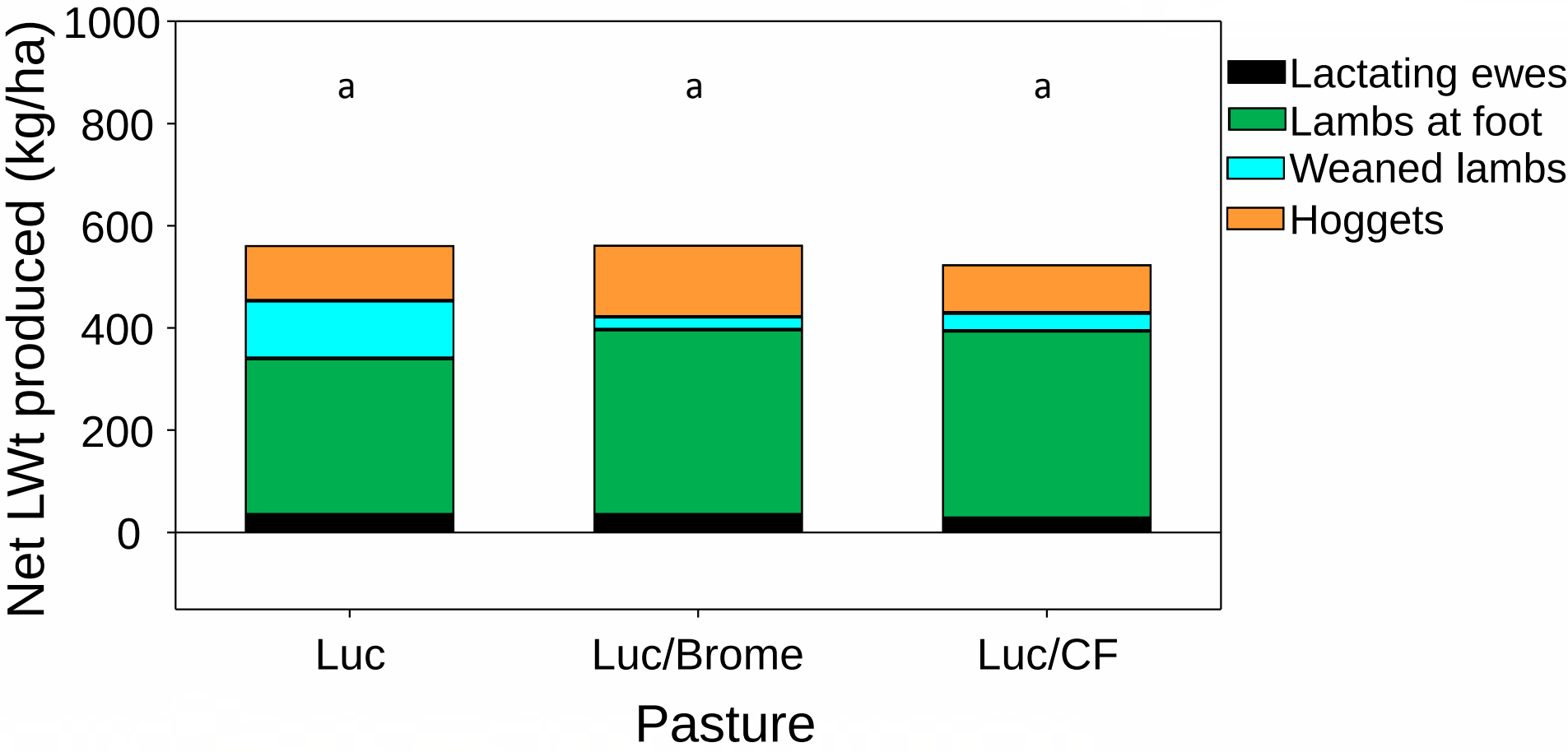
MaxLucerne – Ashley Dene

Net LWt Production by class 2013/14



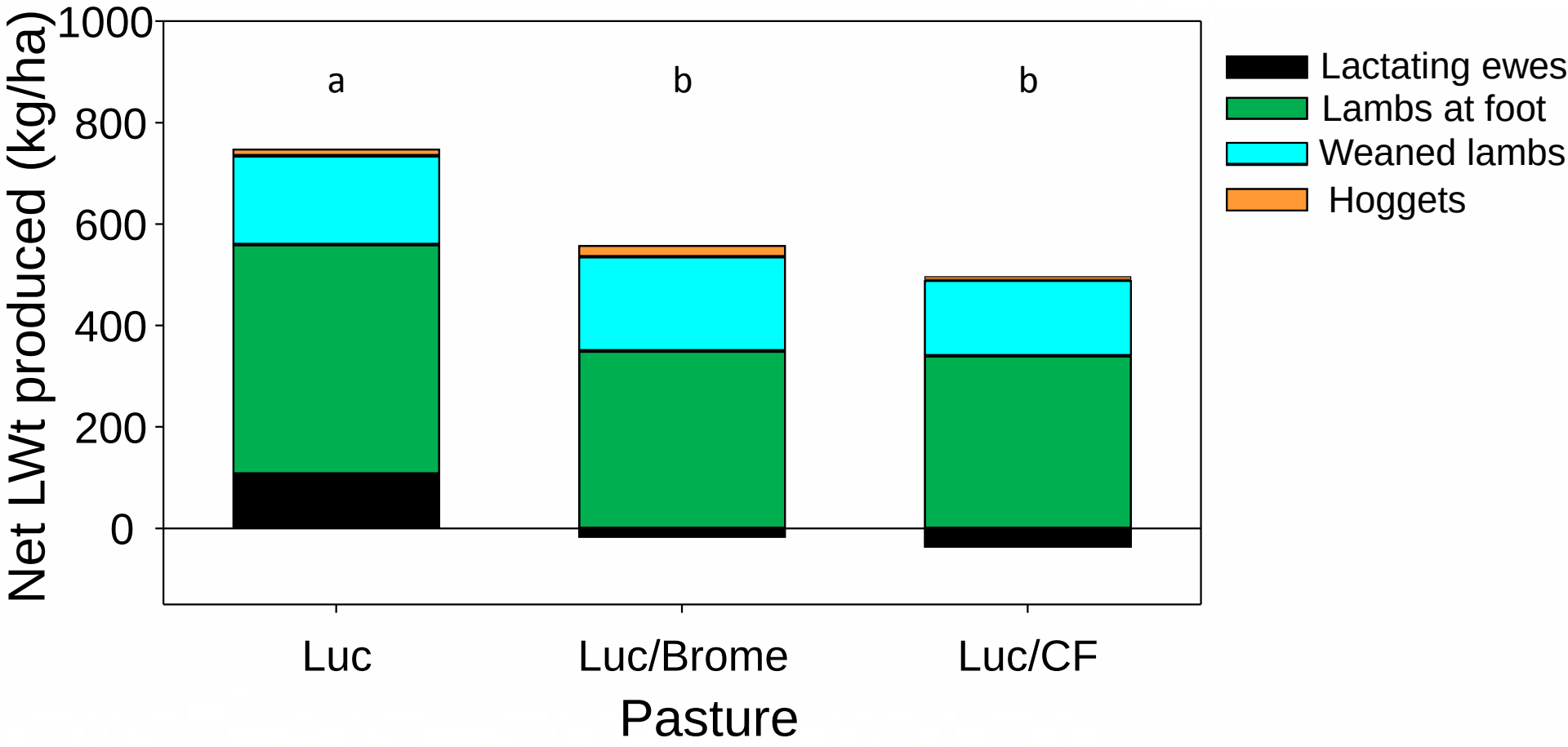
MaxLucerne – Ashley Dene

Net LWt Production by class 2014/15



MaxLucerne – Ashley Dene

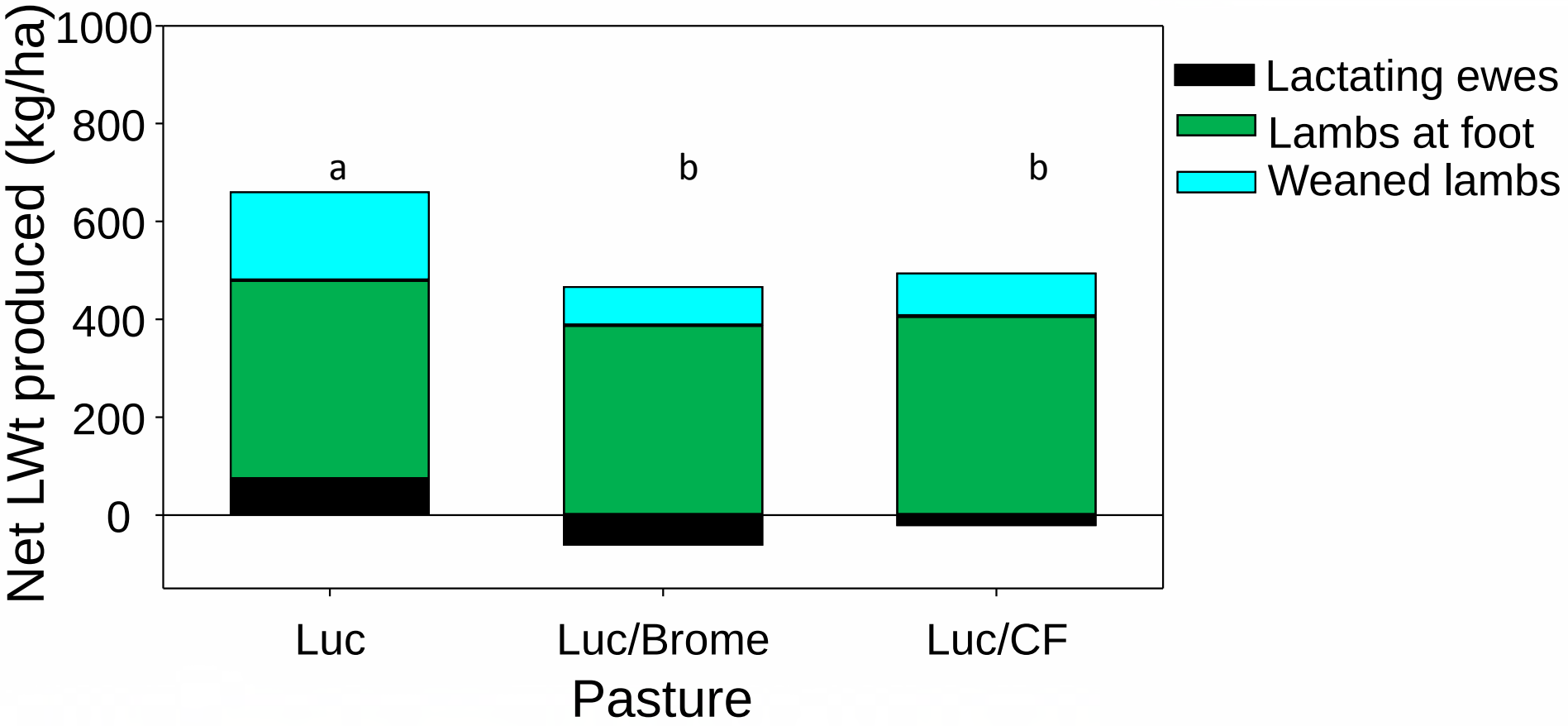
Net LWt Production by class 2015/16



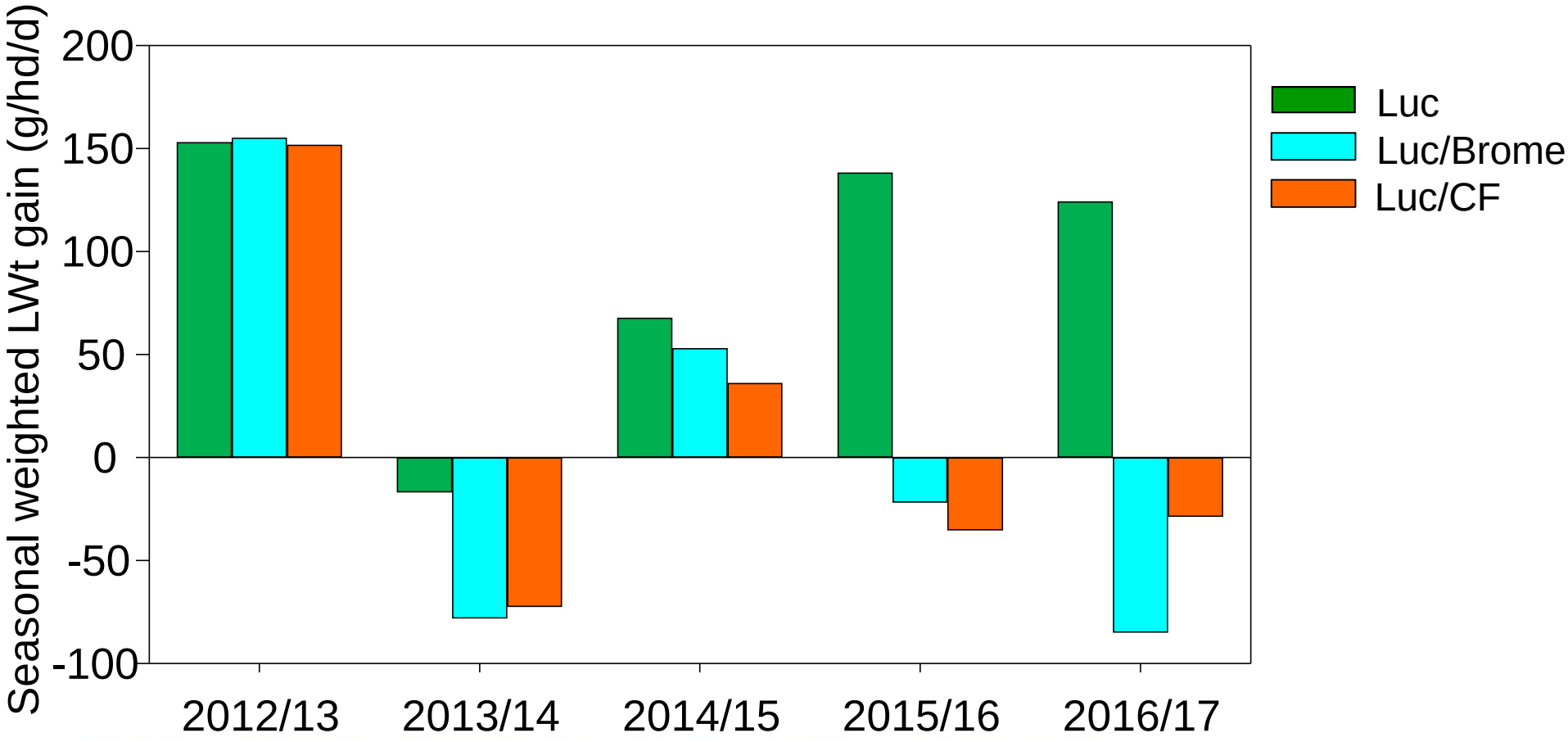
MaxLucerne – Ashley Dene

Net LWt Production by class 2016/17

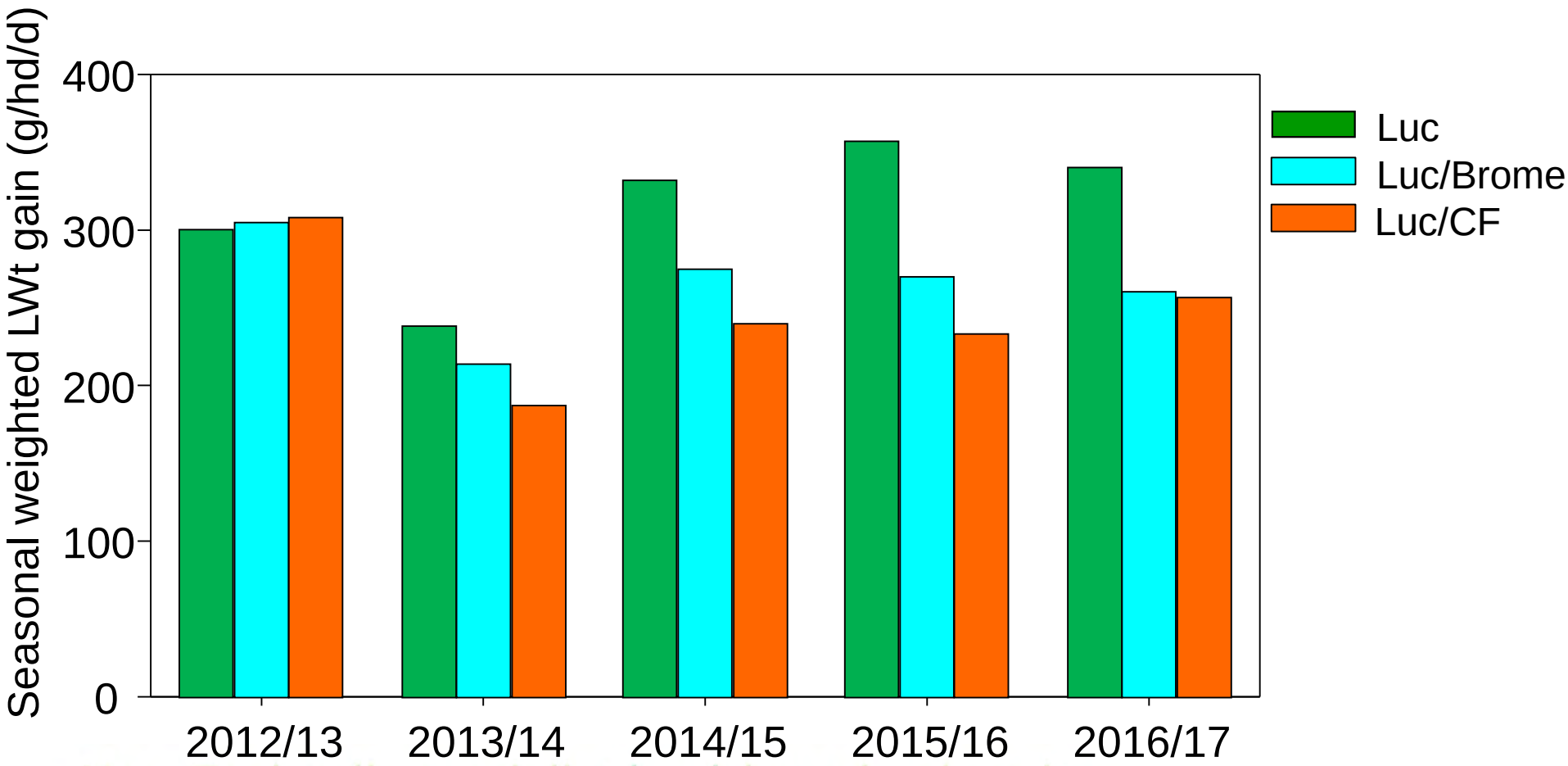
(Terminated Feb 2017)



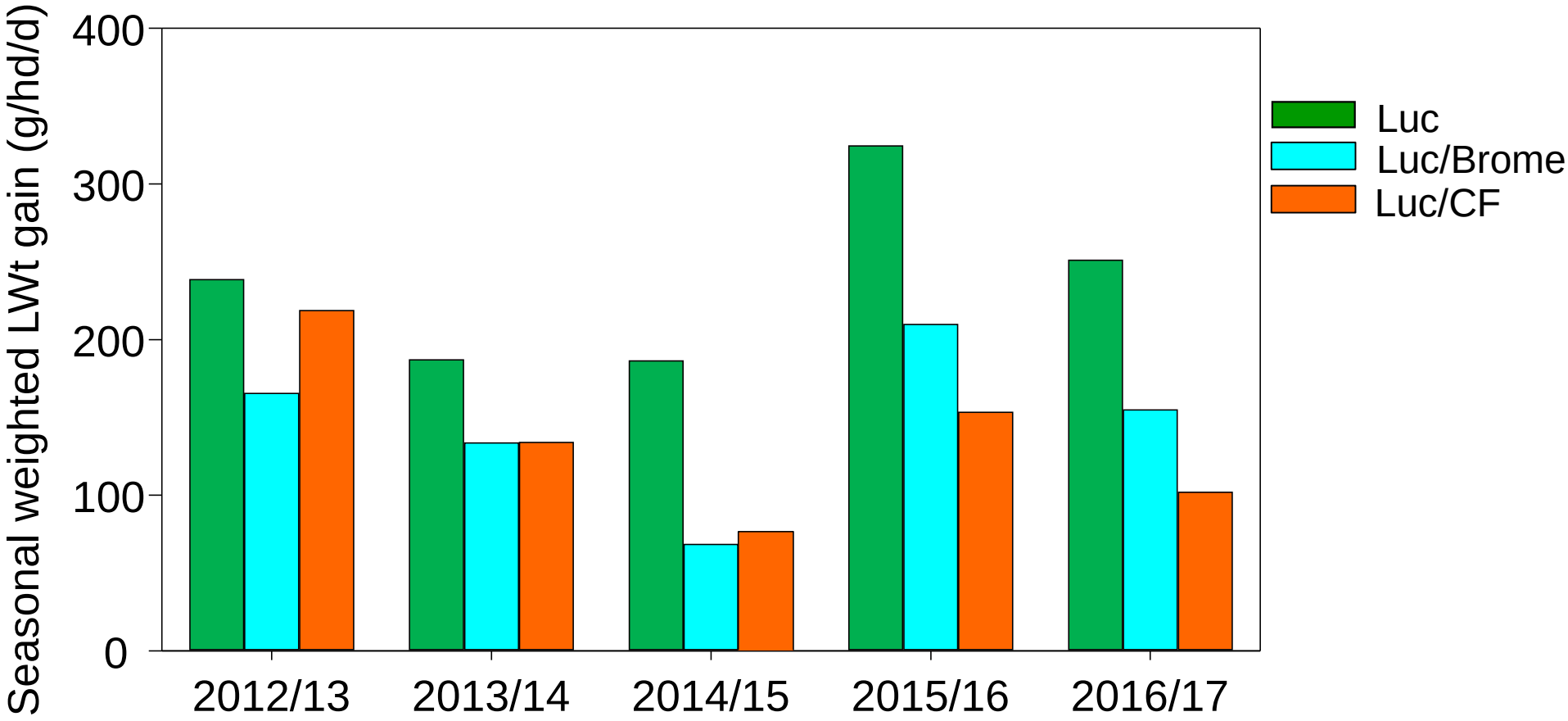
LWt gain of lactating ewes in spring



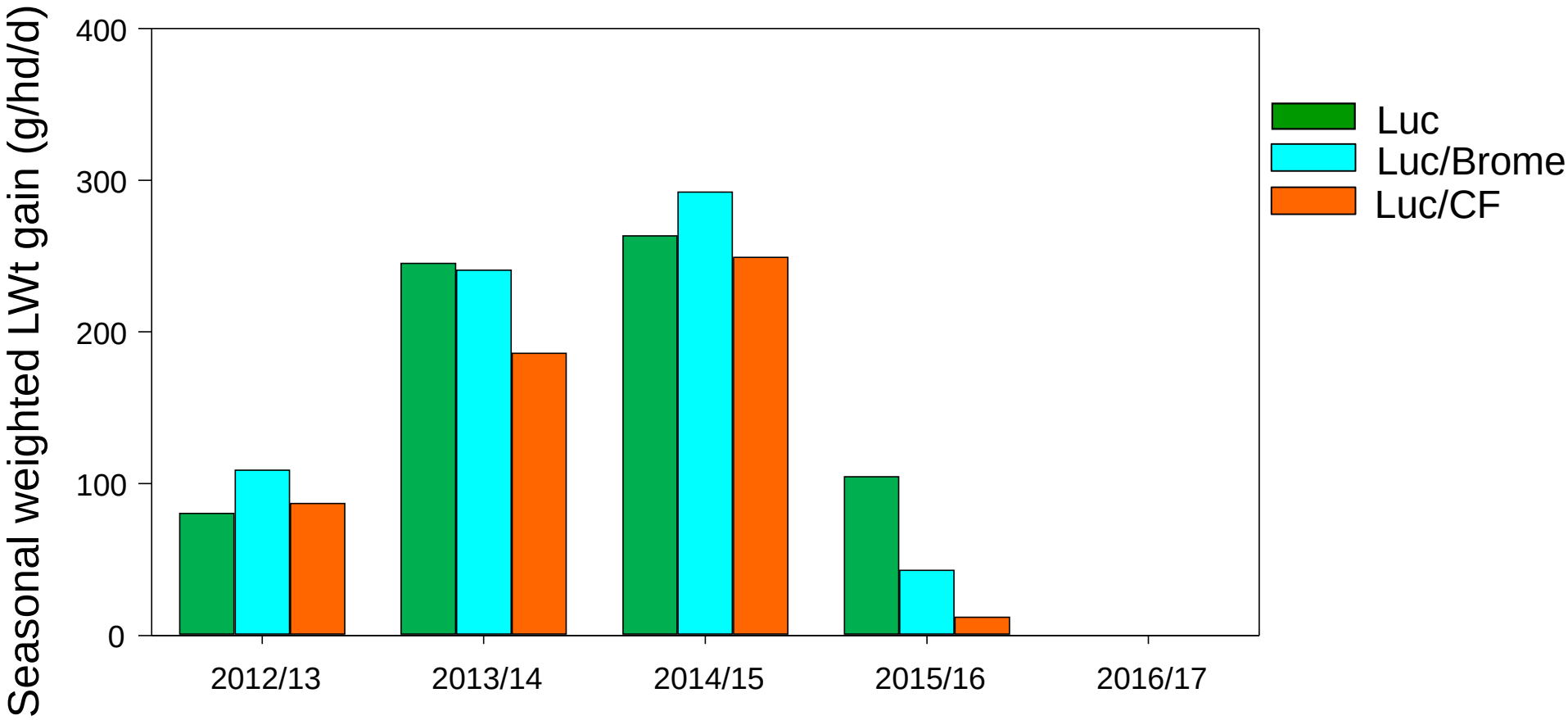
LWt gain of suckling twin lambs in spring



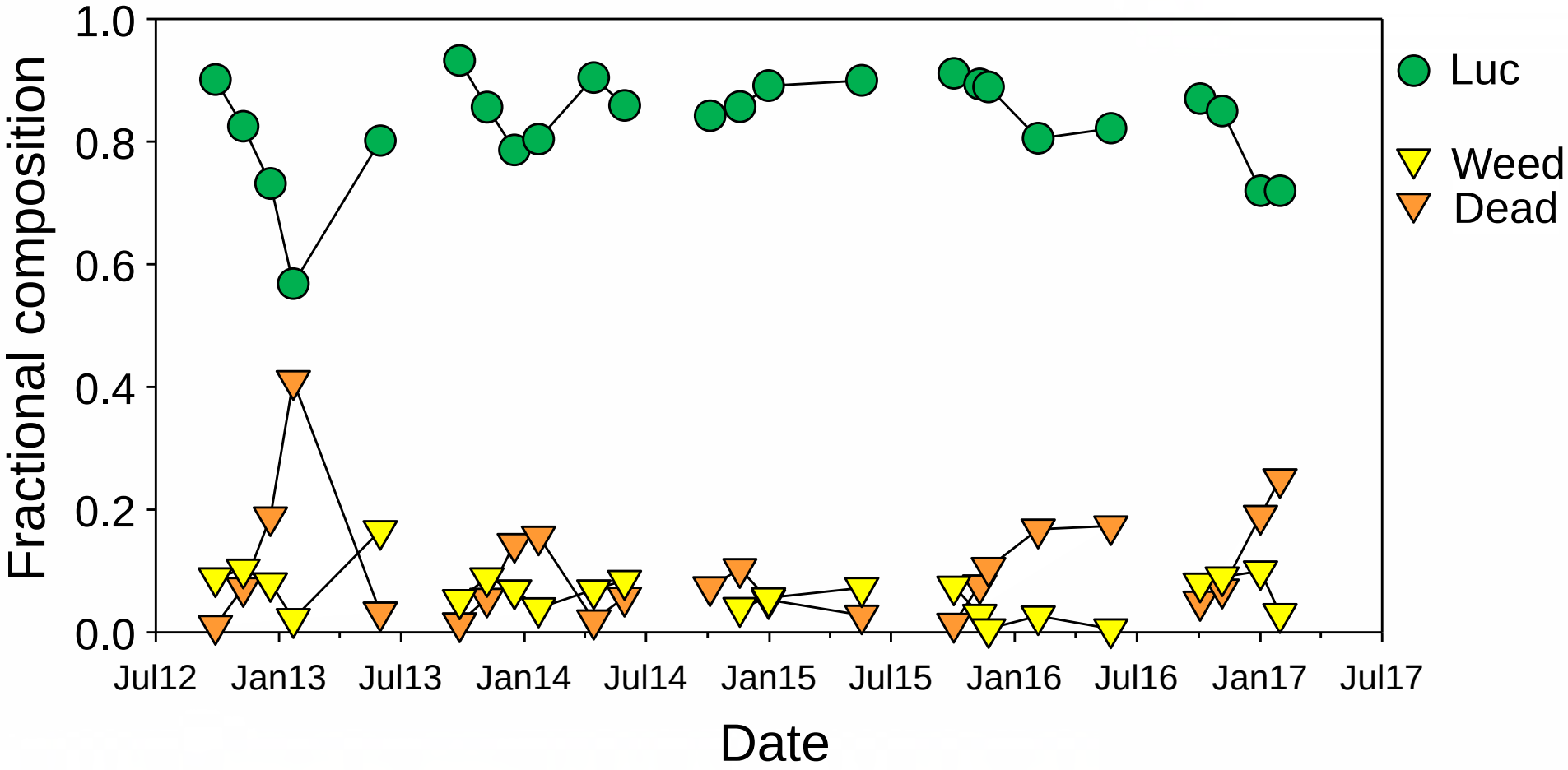
LWt gain of weaned lambs in summer



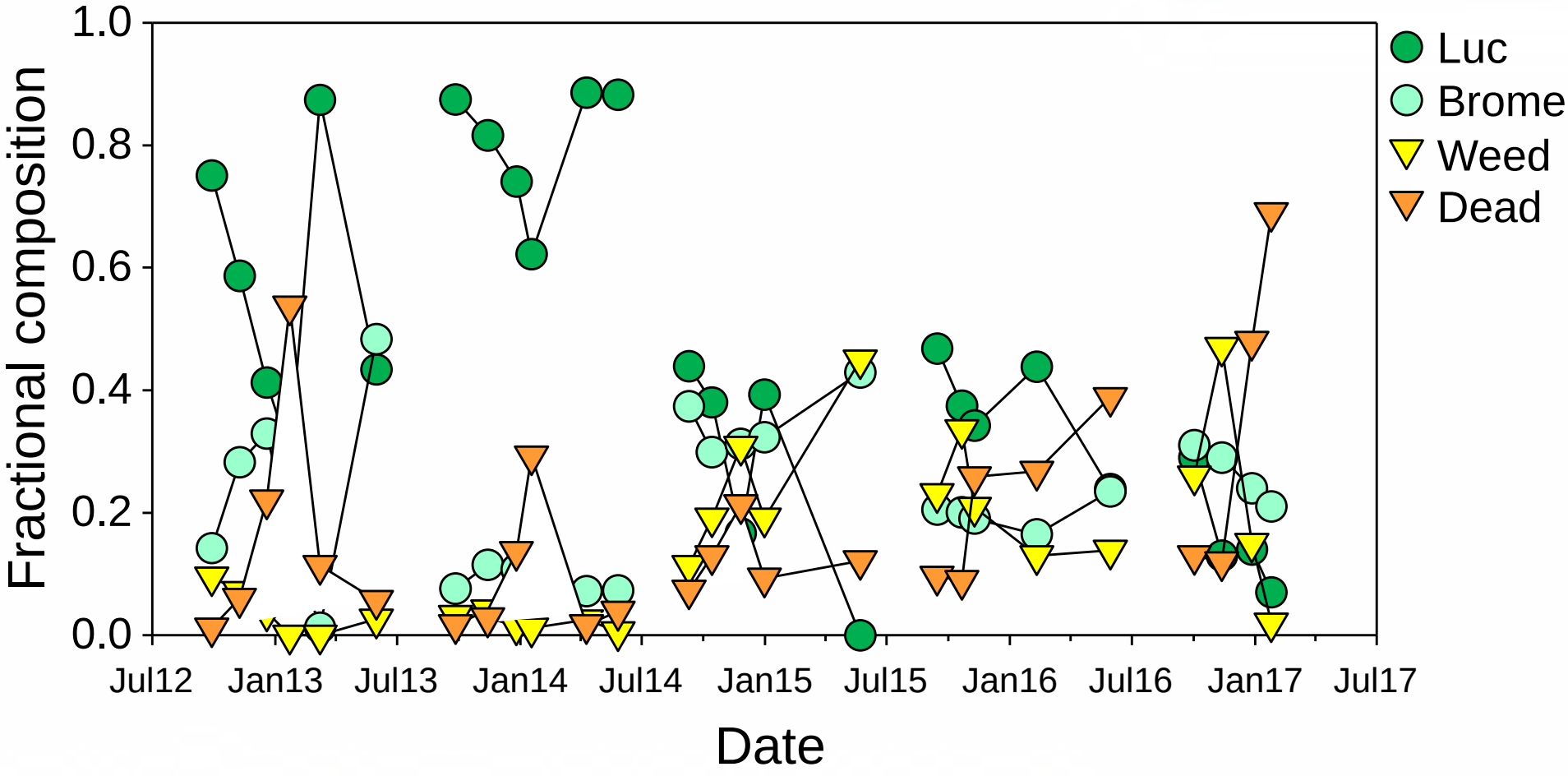
LWt gain of hoggets in autumn



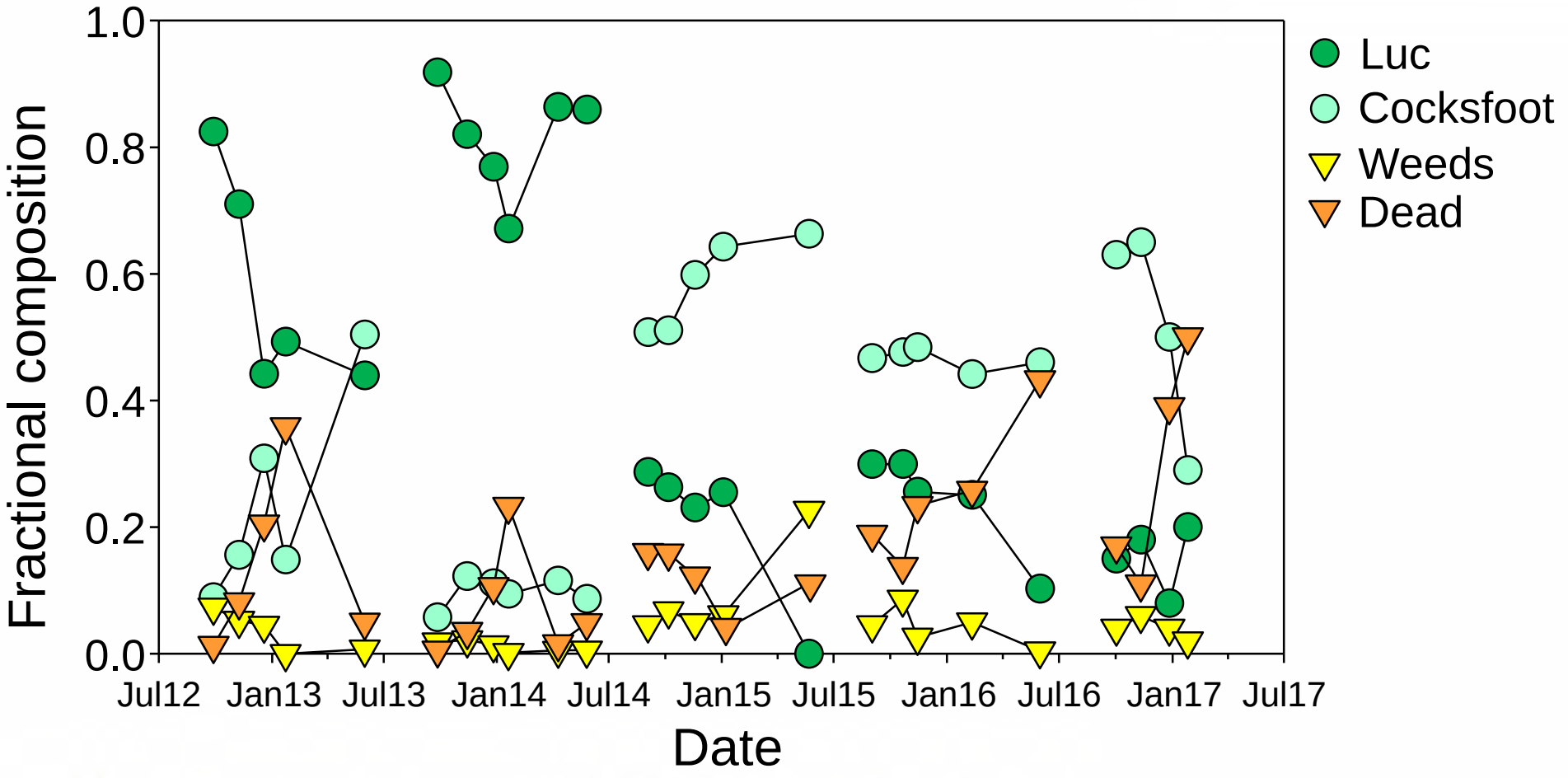
MaxLucerne – Ashley Dene
Composition of lucerne monocultures



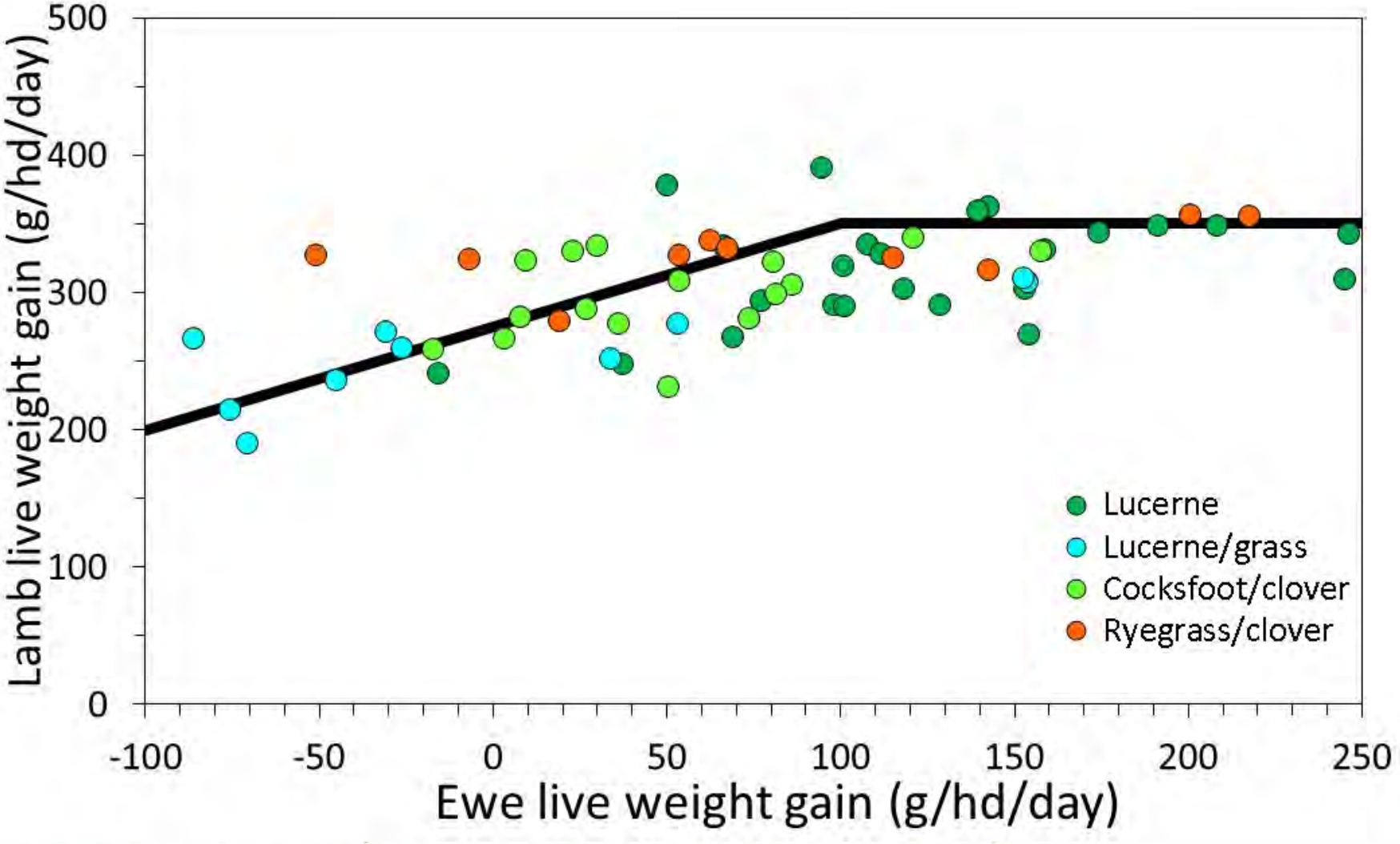
MaxLucerne – Ashley Dene
Composition of Luc/Brome mixes



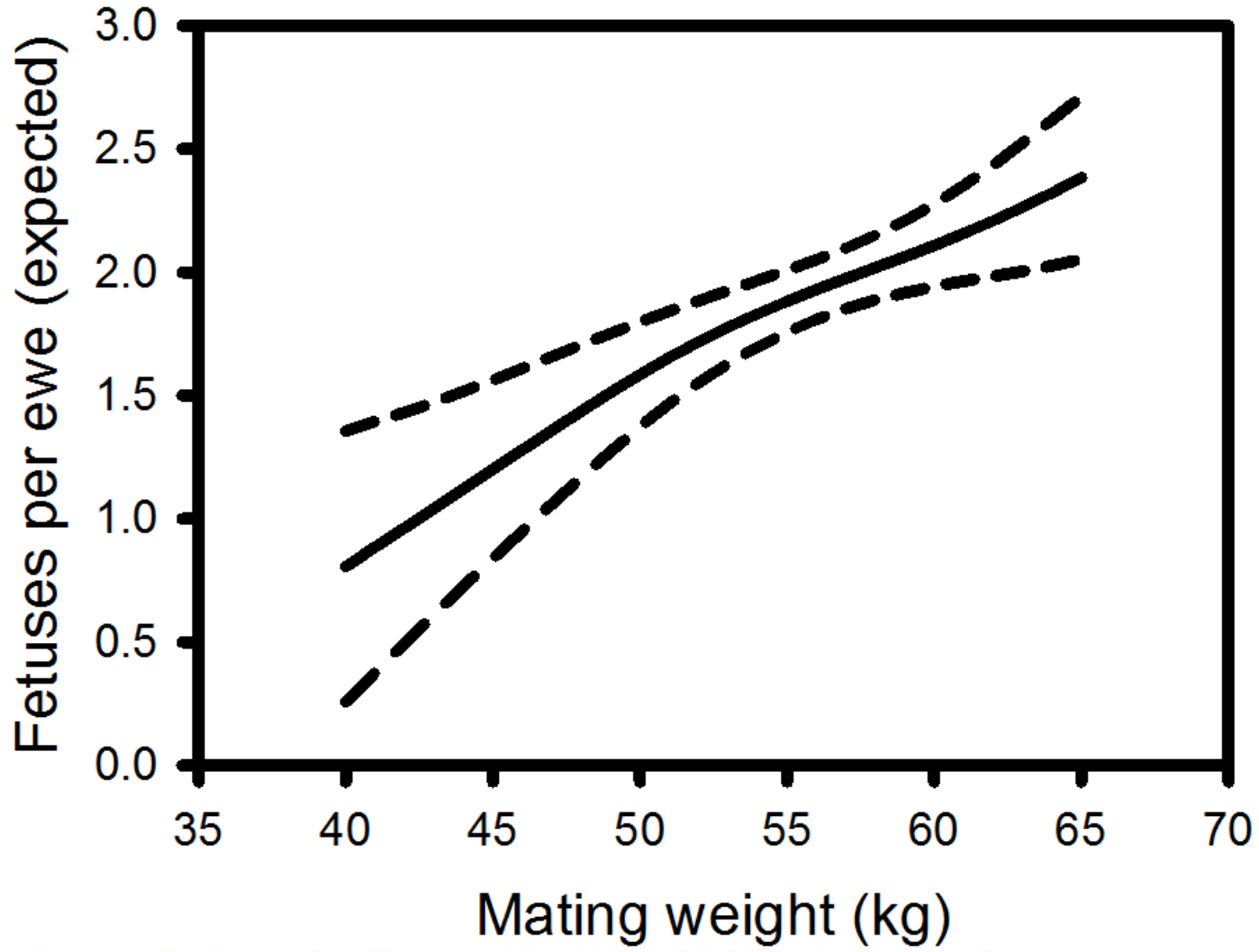
MaxLucerne – Ashley Dene
Composition of Luc/Cocksfoot mixes



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



Expected number of fetuses per ewe as live weight increases



Fields *et al*. 2017

Conclusions

- Lucerne is the main legume for dryland
- Lucerne grazing works – ewes!
- Lucerne grass where you need it
- Ewe condition improves pre weaning
- Transformational change is possible
- If you don’t like shifting stock don’t do it

Where to find us:

- Website: http://www.lincoln.ac.nz/dryland
- Blog: https://blogs.lincoln.ac.nz/dryland/
- YouTube: https://www.youtube.com/DrylandPastures
- Facebook: @DrylandPasturesResearch

References

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

Brown, H. E. and Moot, D. J. 2004. Quality and quantity of chicory, lucerne and red clover production under irrigation. *Proceedings of the New Zealand Grassland Association*, **66**, 257-264.

Fields, R., Moot, D. J. and Barrell, G. 2017. Identifying oestrogenic lucerne crops and premating ewe management. Available from: http://www.lincoln.ac.nz/PageFiles/28807/2017-Coumestrol-Extension-Report.pdf, 4 pp.

Kearney, J. K., Moot, D. J. and Pollock, K. M. 2010. On-farm comparison of pasture production in relation to rainfall in Central Otago. *Proceedings of the New Zealand Grassland Association*, **72**, 121-126.

Kerr, P. 2010. 400 plus - a guide to improved lamb growth. New Zealand Sheep Council in association with WoolPro and Meat New Zealand. 107 pp.

Lucas, R. J., Smith, M. C., Jarvis, P., Mills, A. and Moot, D. J. 2010. Nitrogen fixation by subterranean and white clovers in dryland cocksfoot pastures. *Proceedings of the New Zealand Grassland Association*, **72**, 141-146.

Mills, A. 2007. Understanding constraints to cocksfoot (*Dactylis glomerata* L.) based pasture production, PhD thesis, Lincoln University, Canterbury. Online access: http://researcharchive.lincoln.ac.nz/dspace/bitstream/10182/32/1/mills_phd.pdf. 202 pp.

Mills, A., Moot, D. J. and Jamieson, P. D. 2009. Quantifying the effect of nitrogen of productivity of cocksfoot (*Dactylis glomerata* L.) pastures. *European Journal of Agronomy*, **30**, 63-69.

Mills, A., Moot, D. J. and McKenzie, B. A. 2006. Cocksfoot pasture production in relation to environmental variables. *Proceedings of the New Zealand Grassland Association*, **68**, 89-94.

Moot, D. J. and Avery, D. 2013. Sustainable intensification of livestock grazing systems in low rainfall regions of New Zealand. *First International Conference on Global Food Security*, O3.O3 (4 pgs).

Moot, D. J., Brown, H. E., Pollock, K. and Mills, A. 2008. Yield and water use of temperate pastures in summer dry environments. *Proceedings of the New Zealand Grassland Association*, **70**, 51-57.

Moot, D. J., Brown, H. E., Teixeira, E. I. and Pollock, K. M. 2003. Crop growth and development affect seasonal priorities for lucerne management. *In:* D. J. Moot (ed). Legumes for Dryland Pastures Proceedings of a New Zealand Grassland Association Inc Symposium held at Lincoln University, 18-19 November, 2003. Christchurch: New Zealand Grassland Association, 201-208.

Moot, D. J., Pollock, K. M. and Lewis, B. 2012. Plant population, yield and water use of lucerne sown in autumn at four sowing rates. *Proceedings of the New Zealand Grassland Association*, **74**, 97-102.

Moot, D.J., Mills, A., Smith, M., Anderson, D., Anderson, L. 2018. Summary of liveweight gains and rotational grazing methods used for sheep grazing alfalfa in New Zealand. In: 2nd World Alfalfa Congress, 11- 14 November 2018, Córdoba, Argentina. Submitted.

Moot, D. J. and Smith, M. Practical Lucerne Management Guide. Date Accessed. http://www.lincoln.ac.nz/PageFiles/23598/Lucerne-management-guide-Col.pdf.