

AAPA

22 October 2014



**Lincoln
University**
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND



Research and extension on alfalfa in New Zealand

Dr Derrick Moot
Professor of Plant Science



New Zealand's specialist land-based university

This work by [Derrick Moot & the Lincoln University Dryland Pastures Research Team](#) is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](#).



New Zealand's specialist land-based university



Value good data

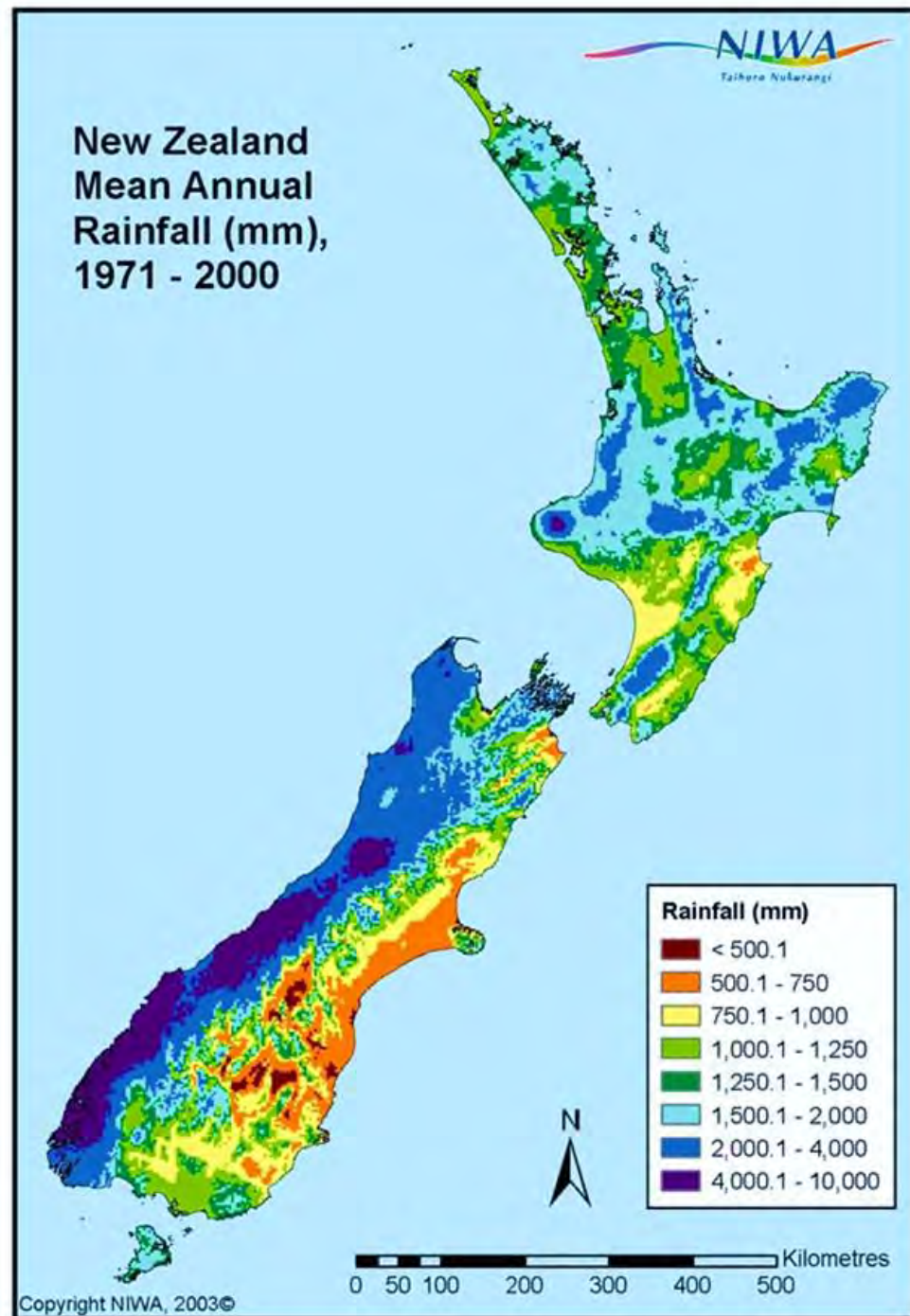
The Village Pub



Roger Protz *and* Homer Sykes



**Strong rainfall gradient
West ⇒ East**

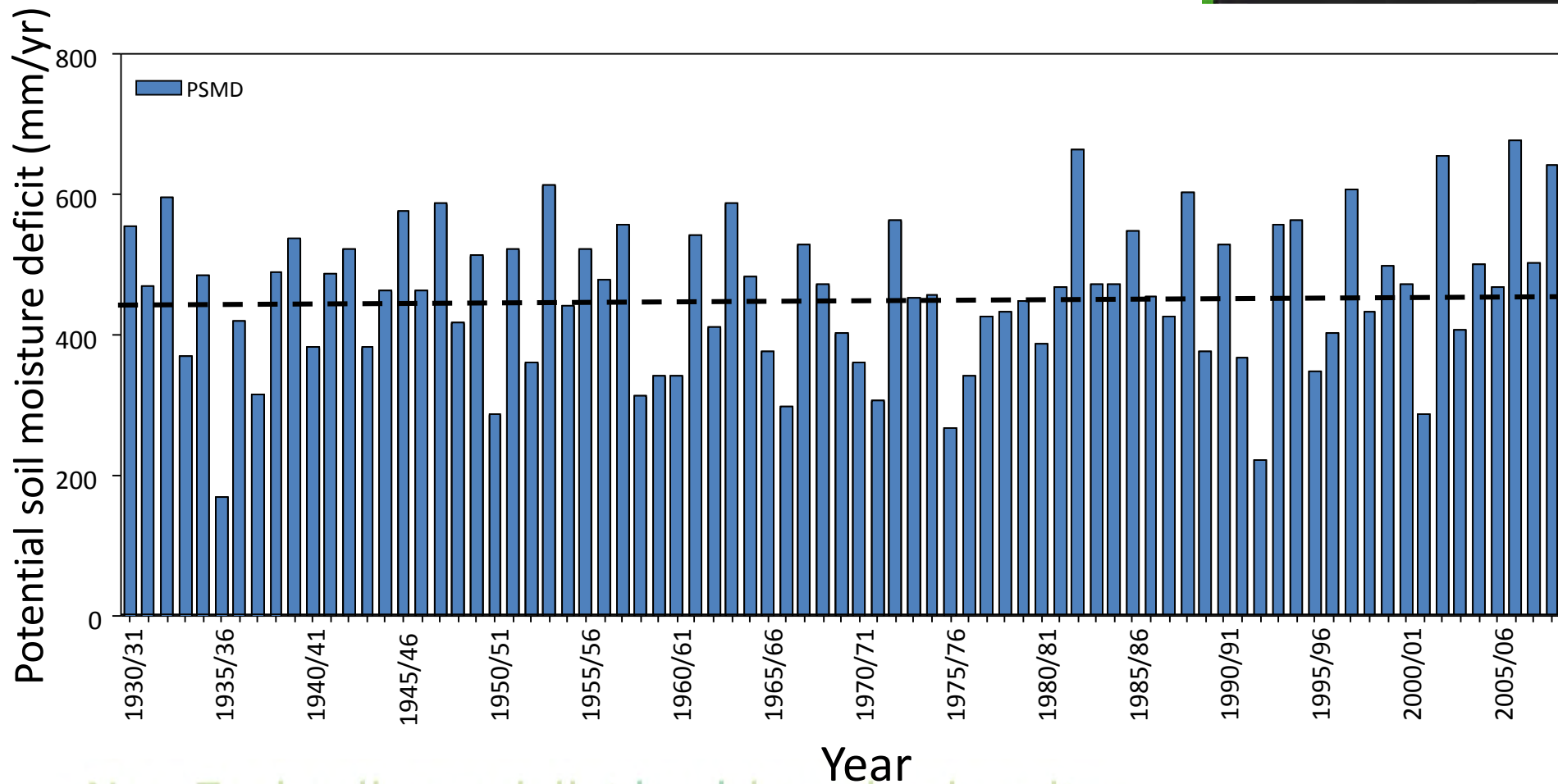




Rain fed 300-800 mm

East coast - summer dry

Soil moisture deficit - Napier



New Zealand's specialist land-based university



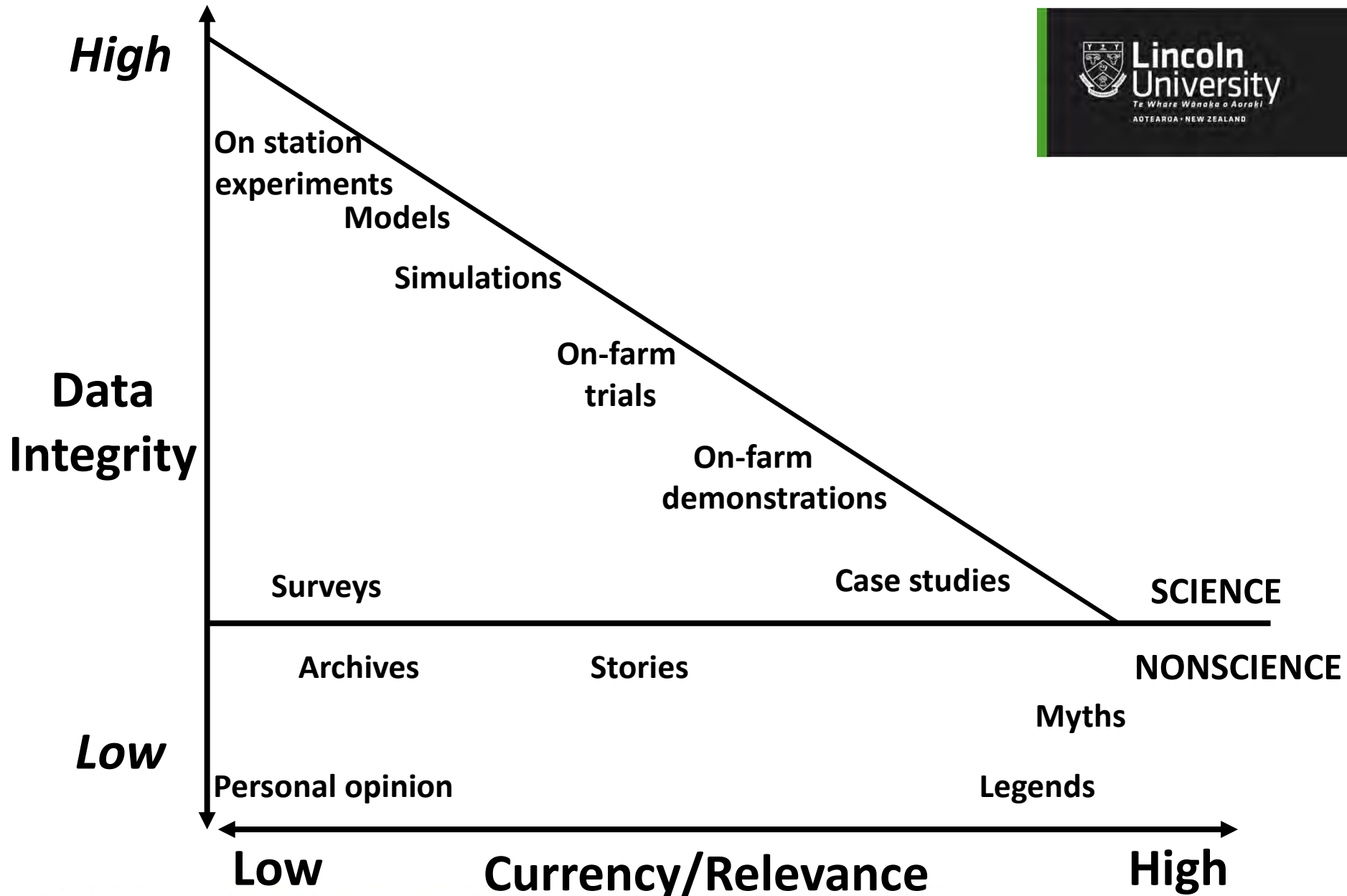
By 2030 - Drier:

**Drought – increased duration and frequency
Dryland pasture species?**

Farmer alfalfa questions

a) Which dryland species and why?

- Red clover, chicory or alfalfa?
- Any better than grasses?
- Hay in spring - autumn grazed



New Zealand's specialist land-based university

Experiment 1 – drought tolerant species



- 65 – 437 mm irrigation
- 7-10 day measurement interval
- 6 years

Main measurements

- Growth and development
- Weekly measurements

Shoots



Crowns and taproots



Leaf appearance & branching

LAI



Measurements

Light environment



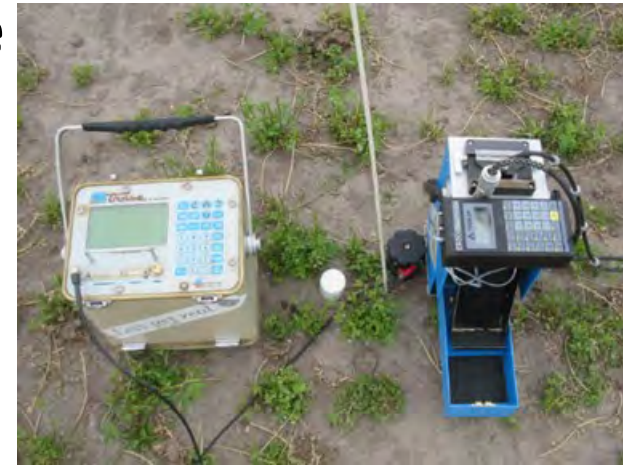
Soil moisture

Chemical Analysis:

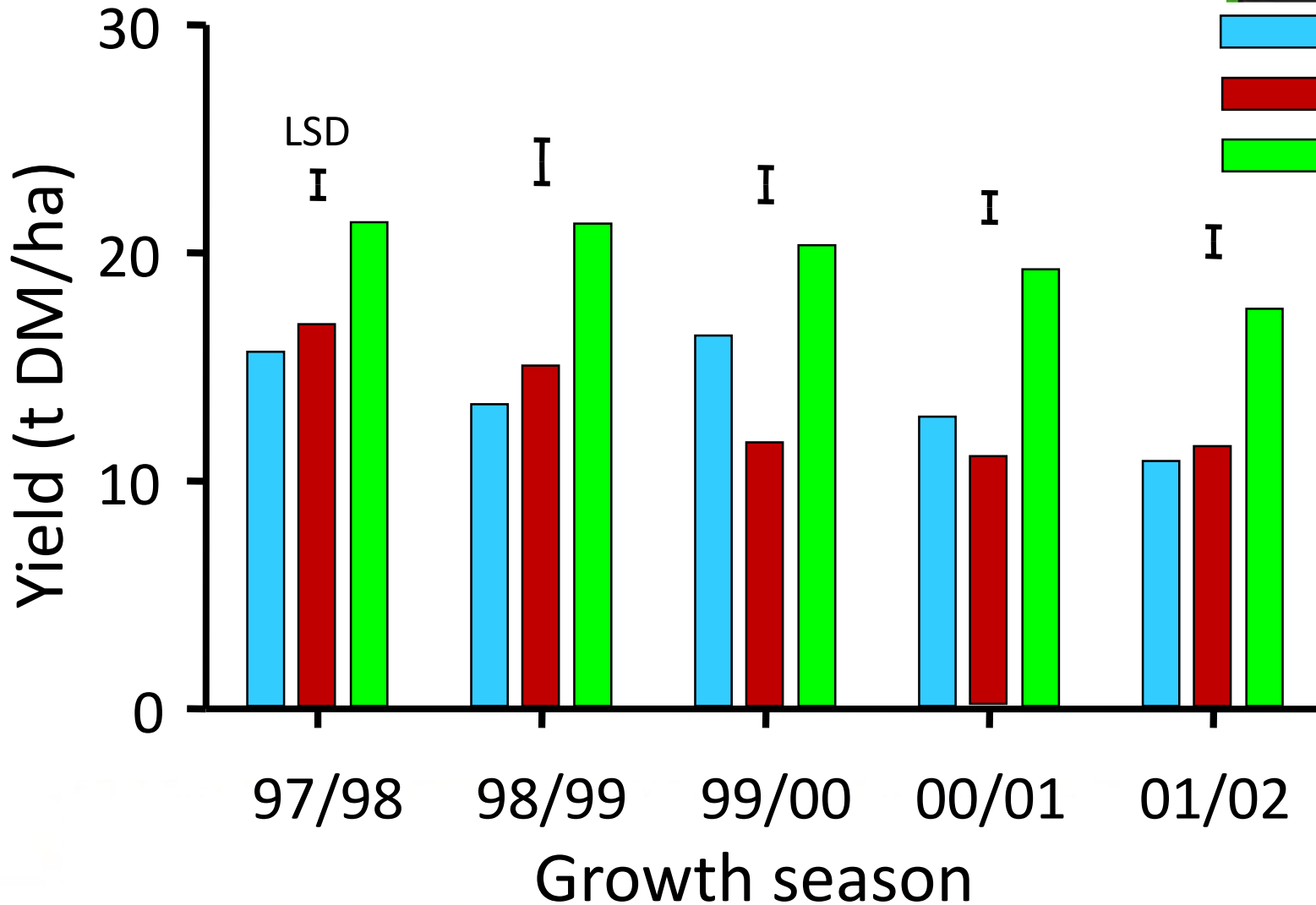
- N (shoots and roots)
- Starch in roots
- Soluble sugars in roots

Temperature

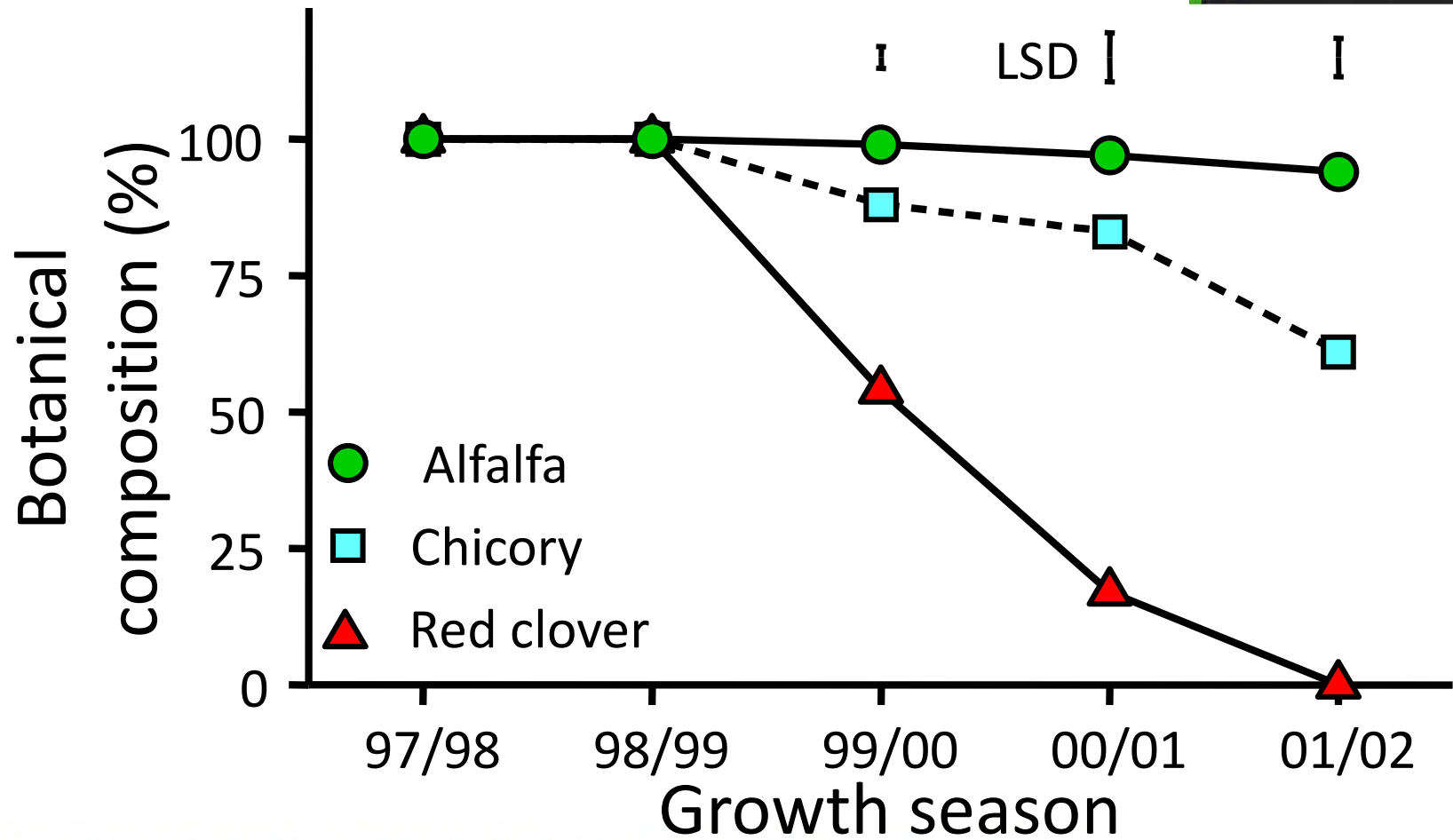
- Air and soil



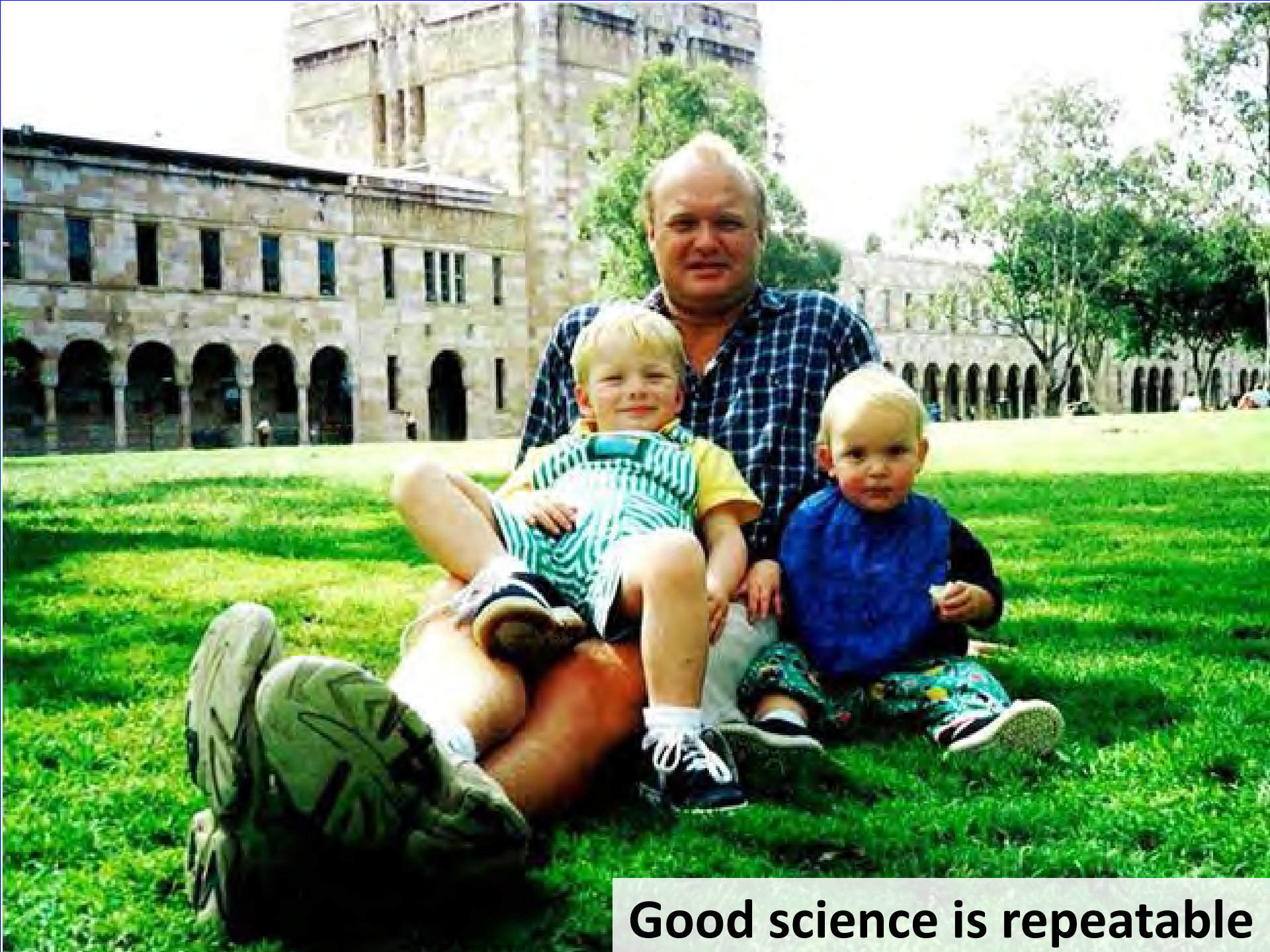
Annual dry matter yields



Persistence

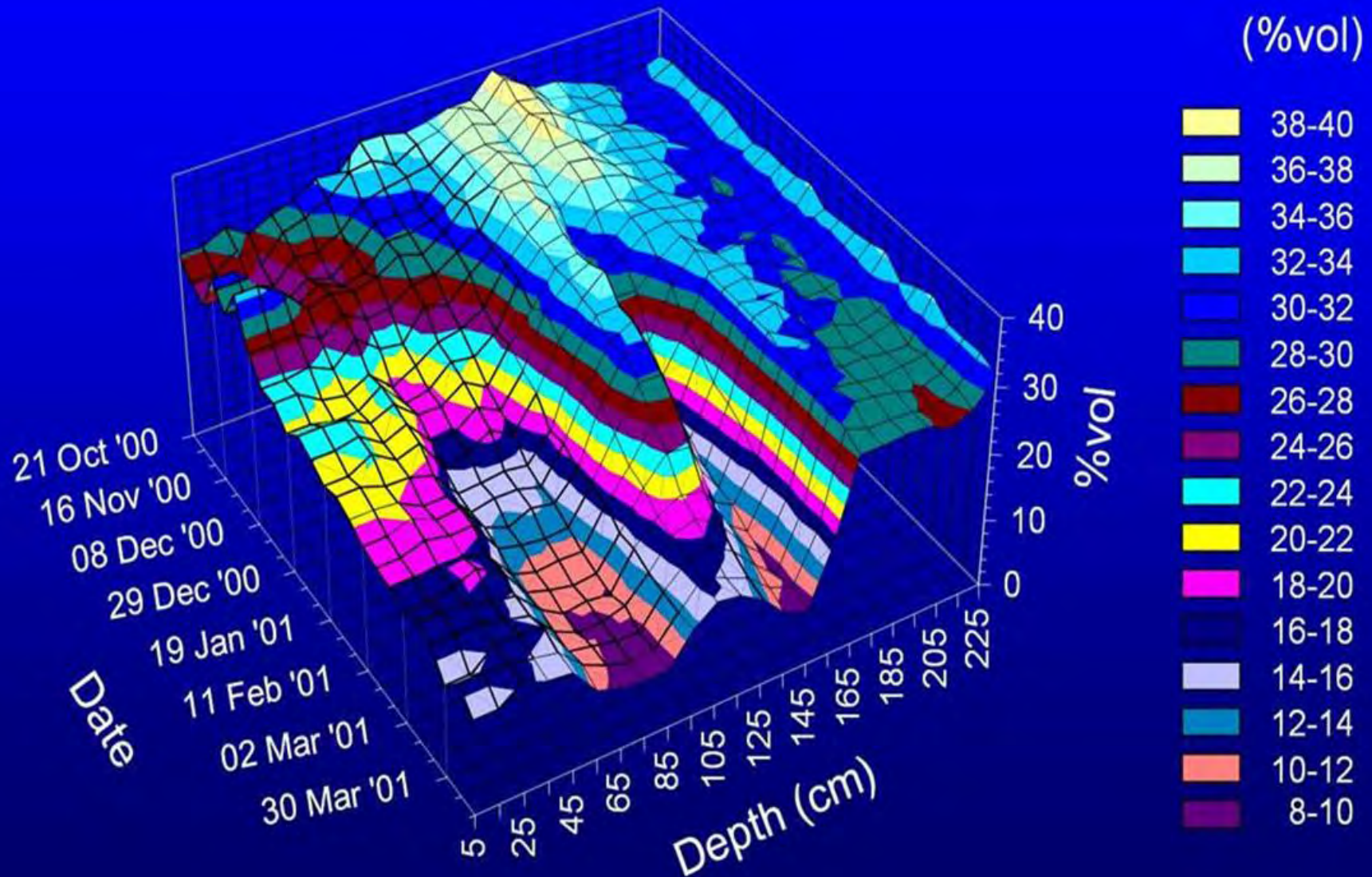


New Zealand's specialist land-based university

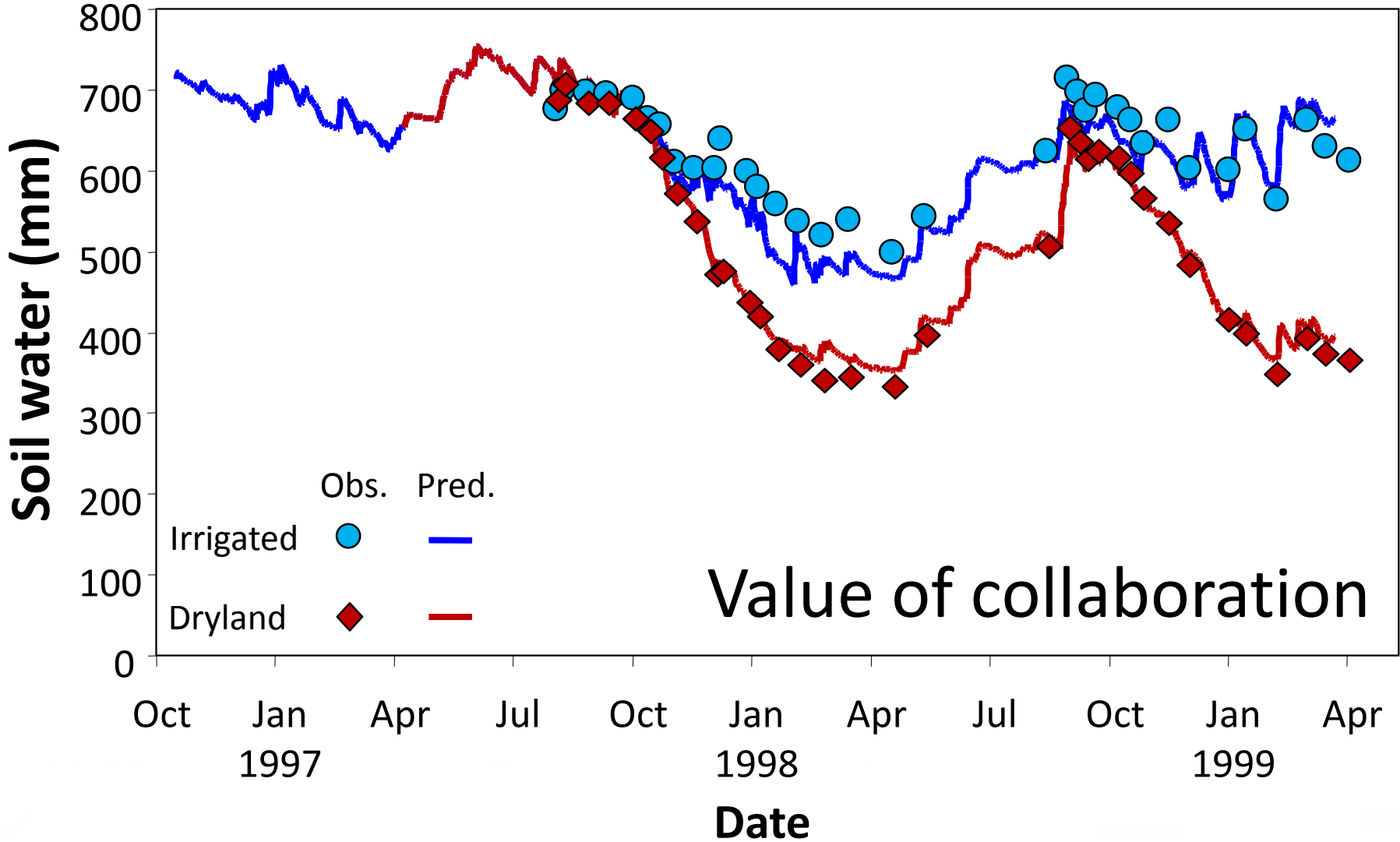


Good science is repeatable

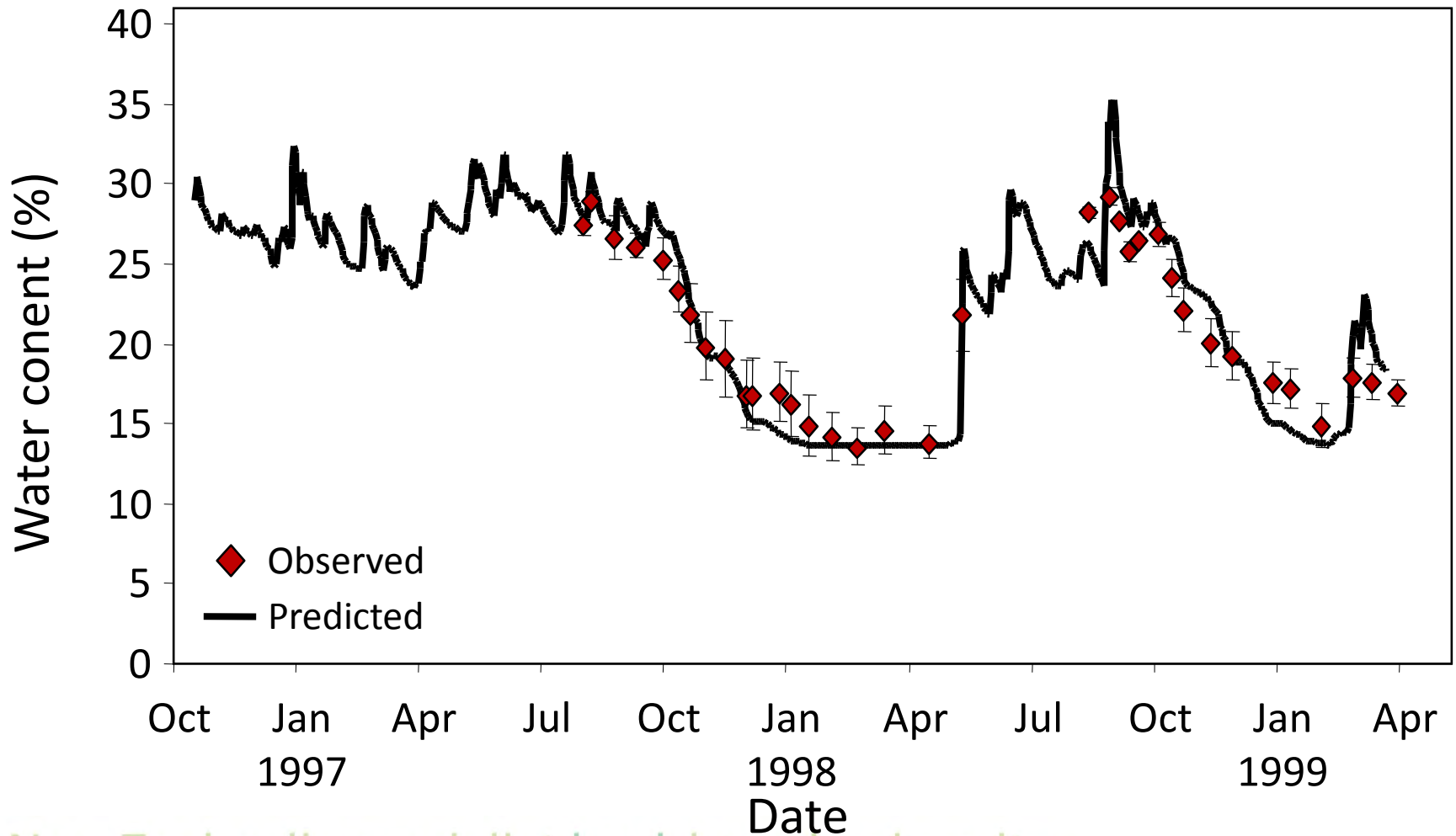
Dryland Alfalfa – soil moisture



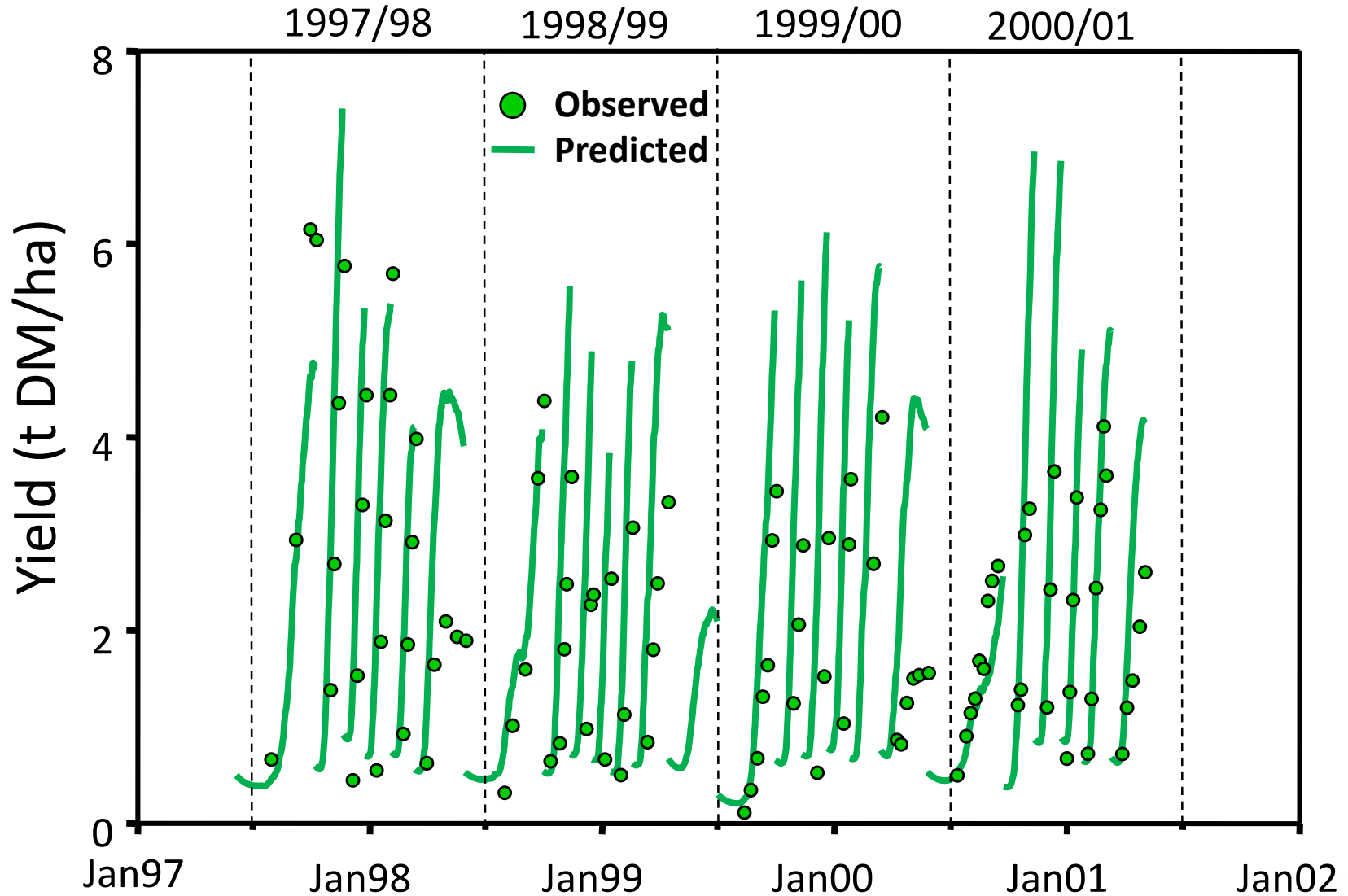
Total soil water to 2.3 m depth



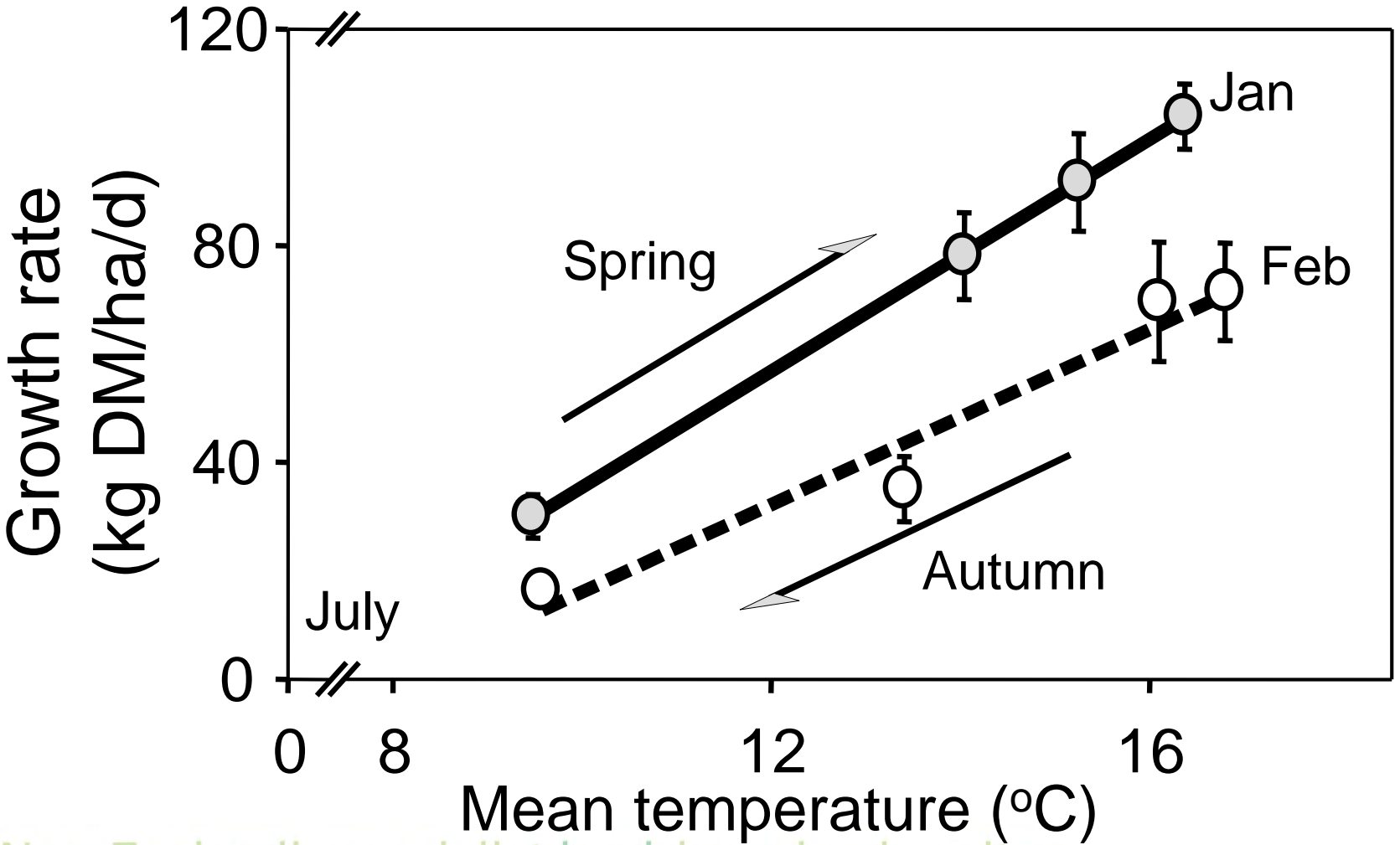
Volumetric soil water at 0.35 m



APSIM_Alfalfa prediction



Vegetative growth



What's happening down there?



Experiment 2

flexible grazing

38 days resting

4 days grazing

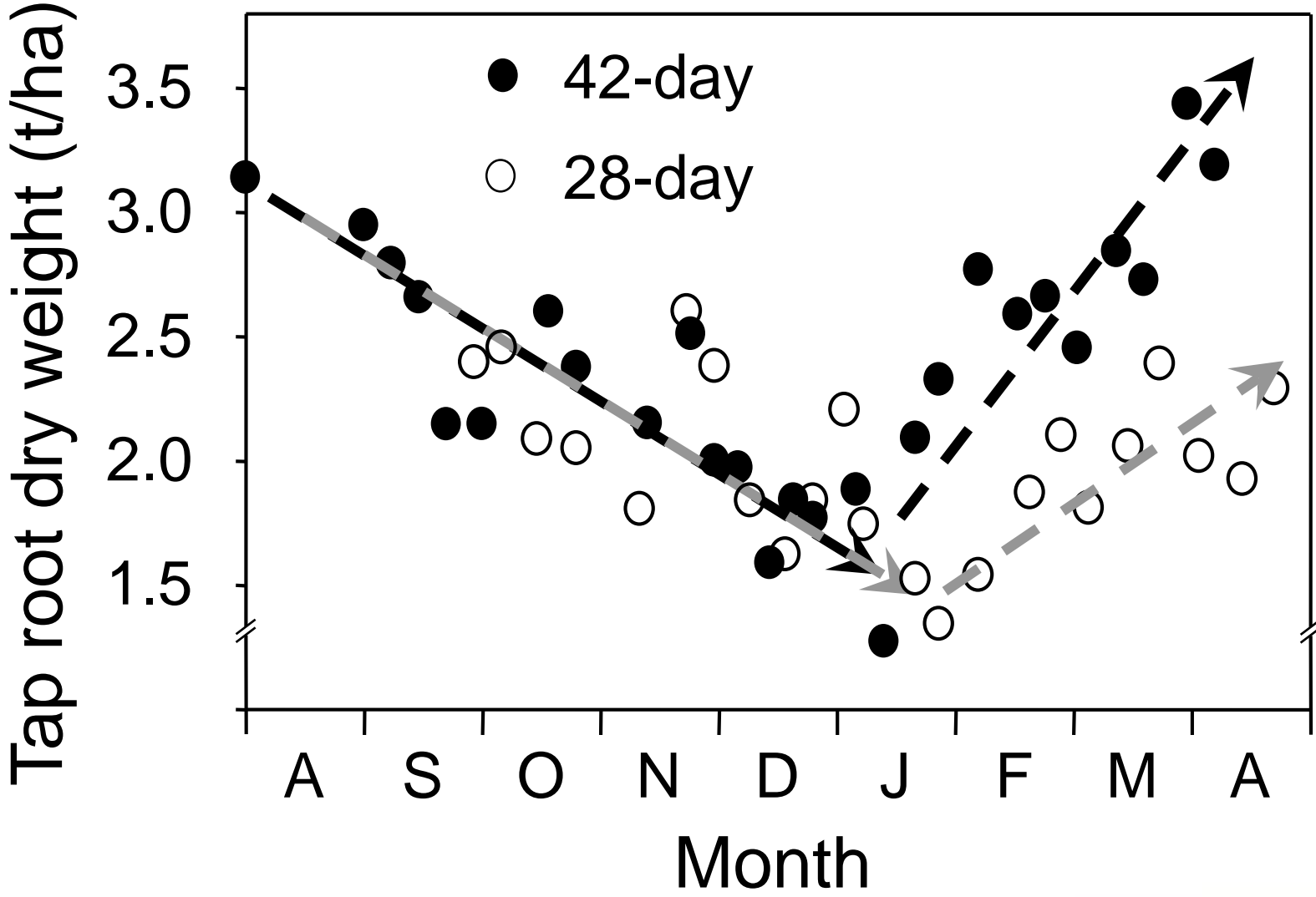


25 days resting

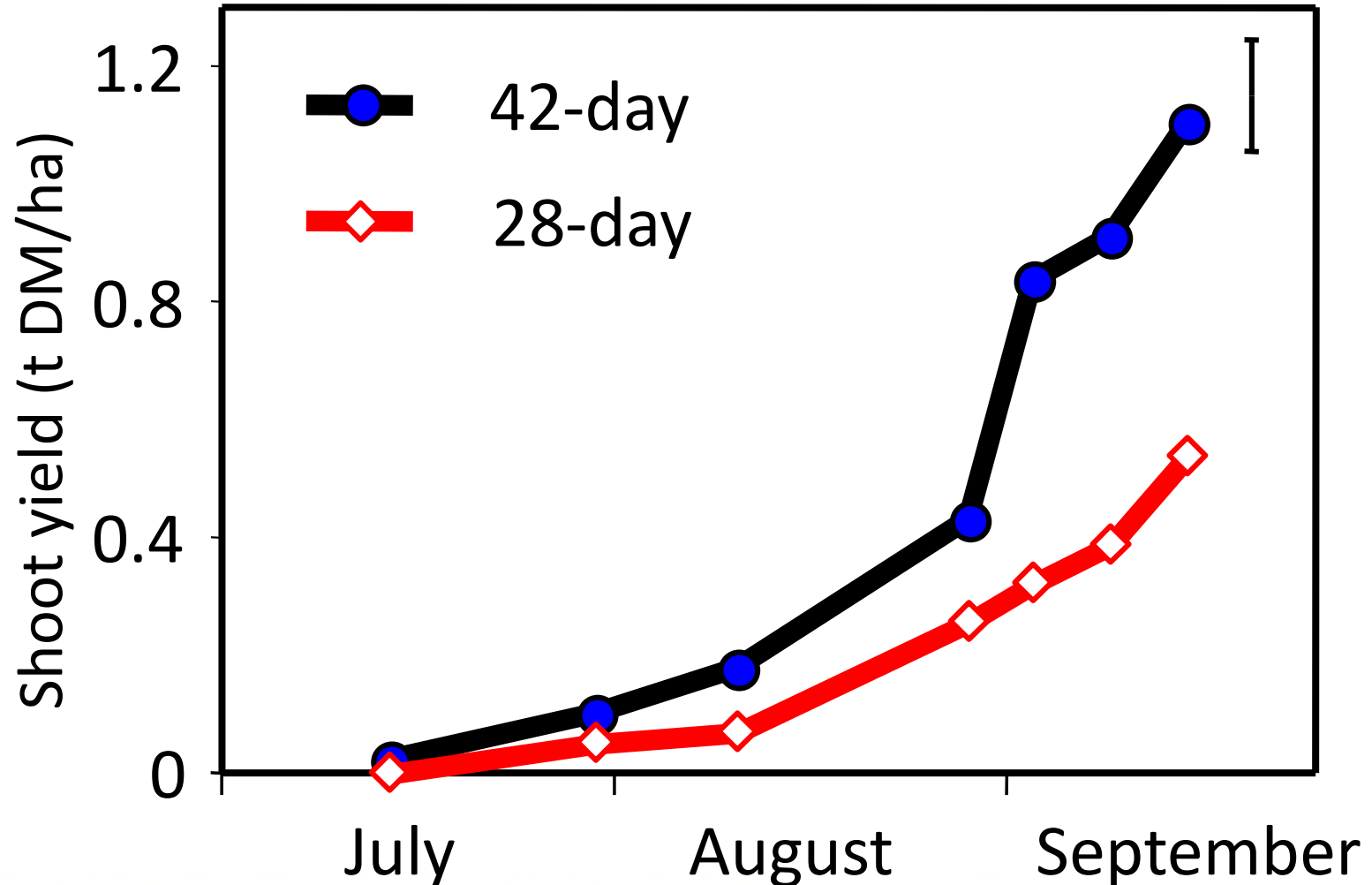
3 days grazing



Partitioning to roots

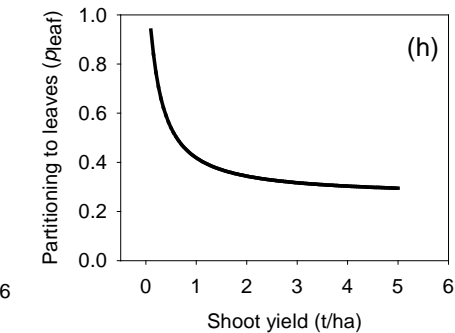
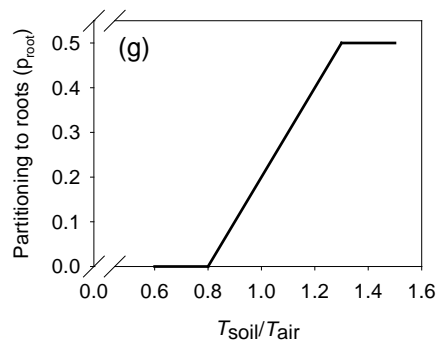
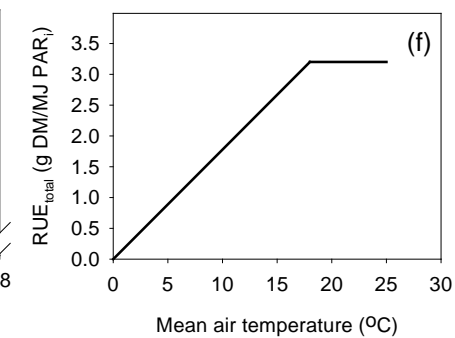
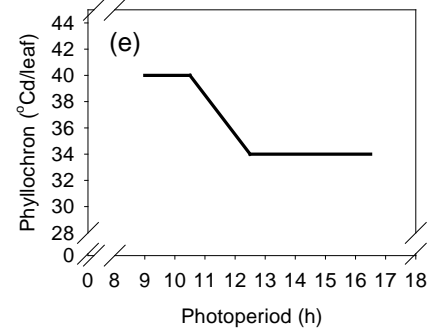
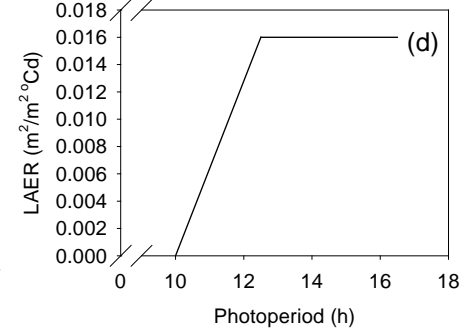
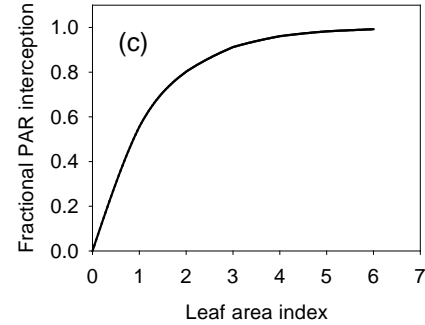
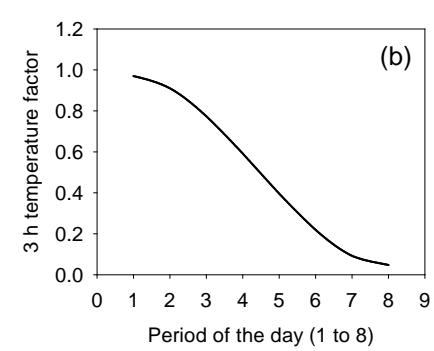
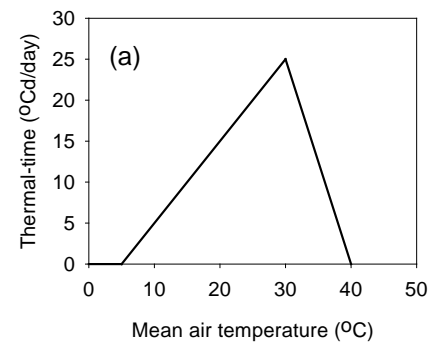
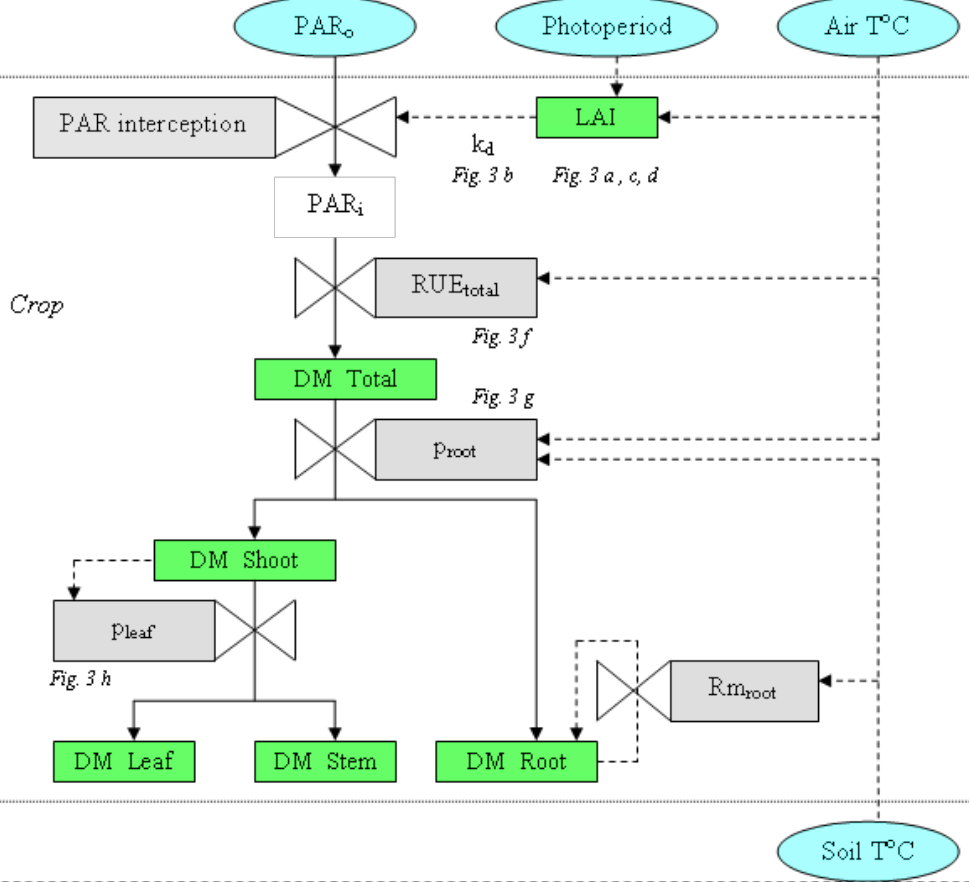


Dry matter production

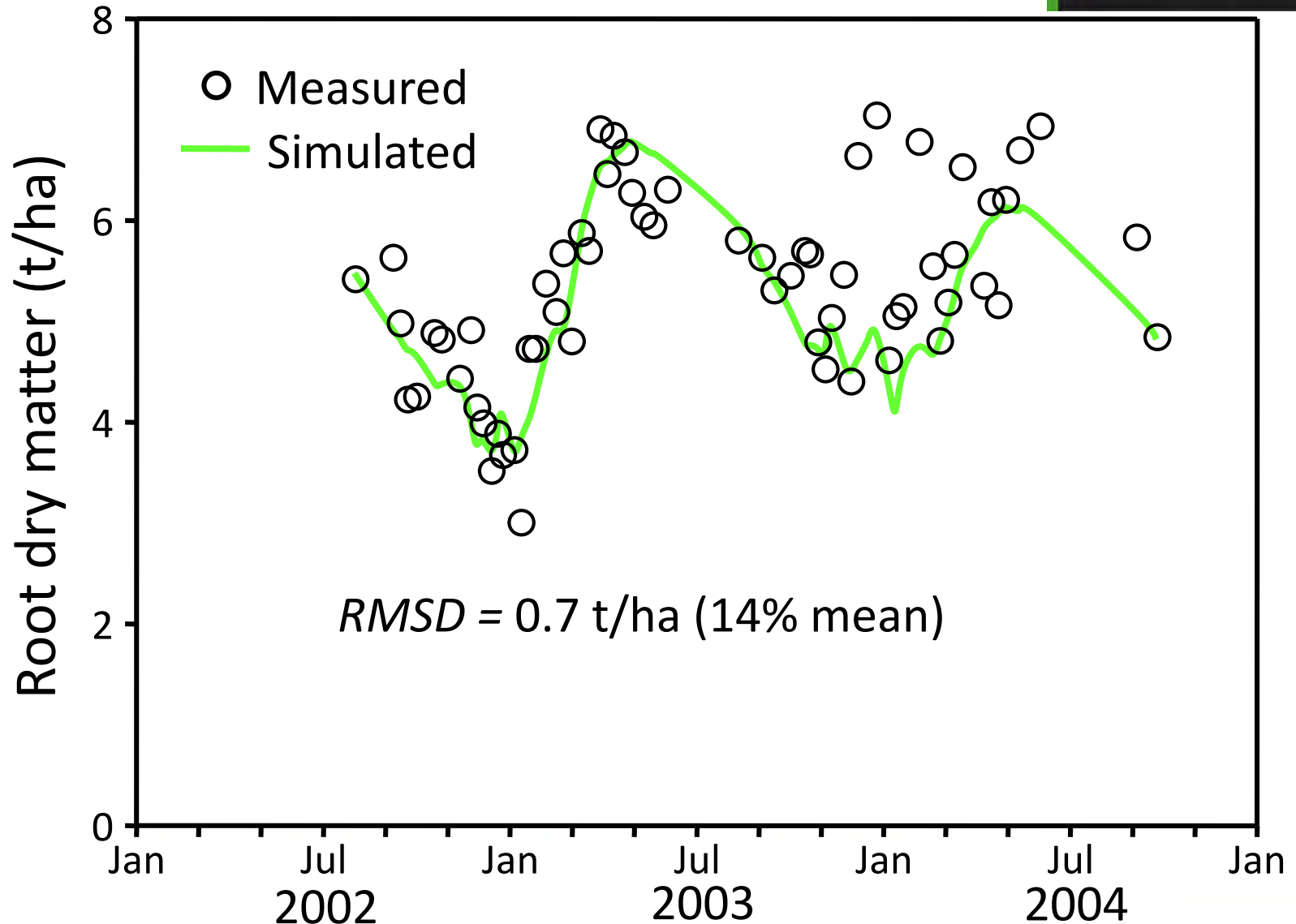


Modelling

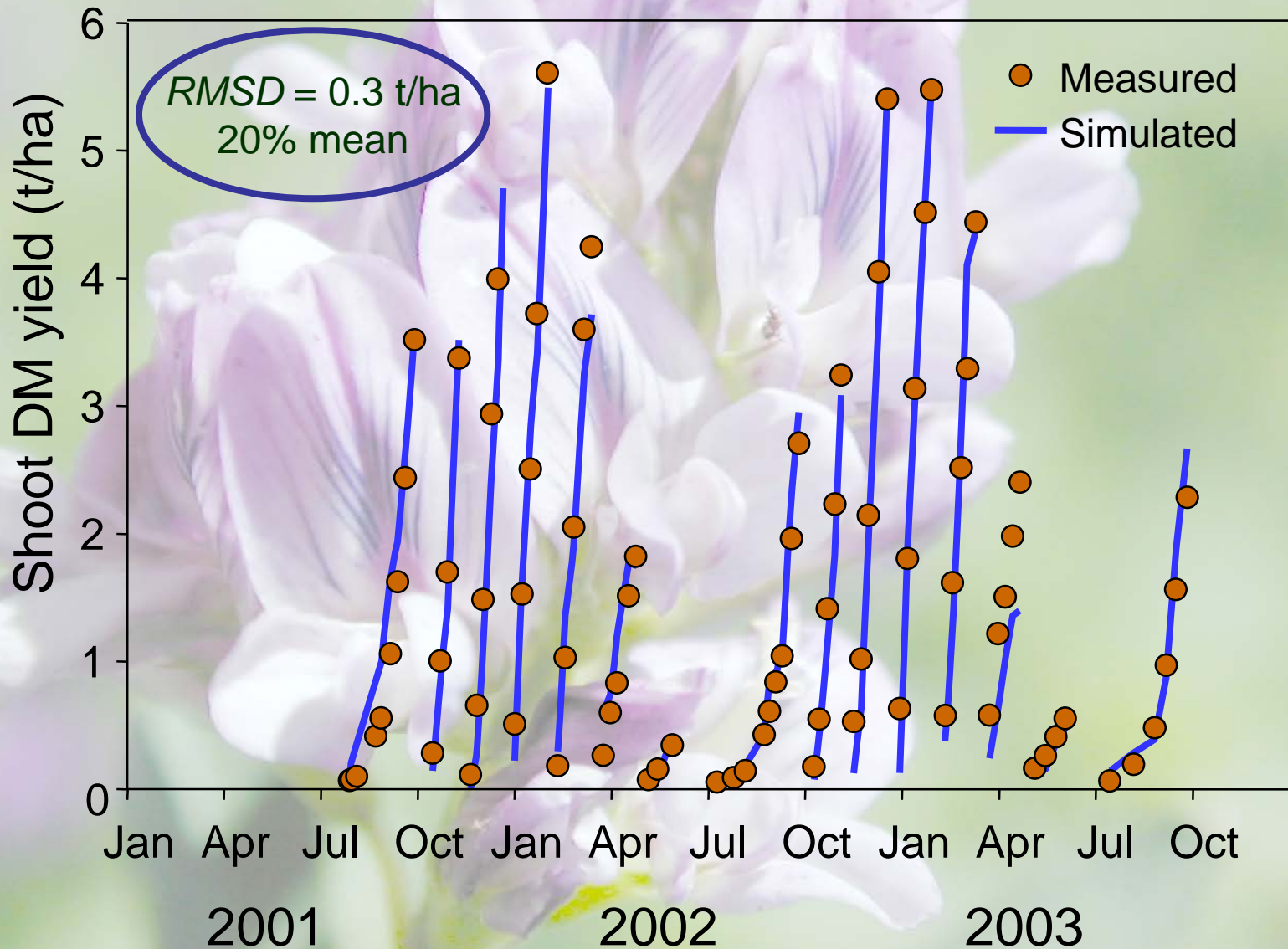
Environmental factors



Adjusting R_m for the best fit

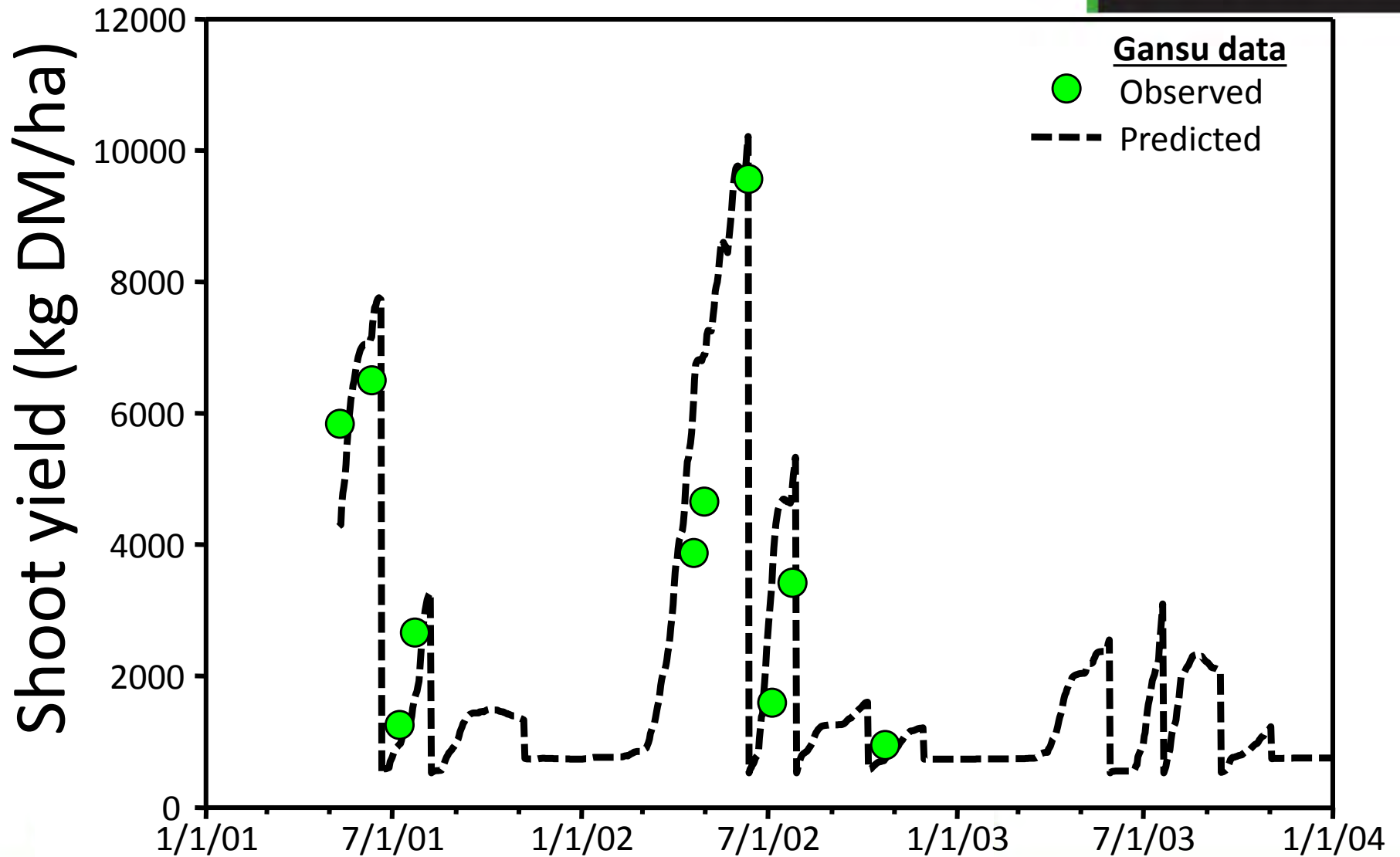


Predictions of shoot yield





Model Validation



Farmer alfalfa issues

b) Defoliation management.

- 10% flowering – basal bud formation
- Average 23% higher but 3-weeks later?
- Ewes and lambs on alfalfa pre-weaning?



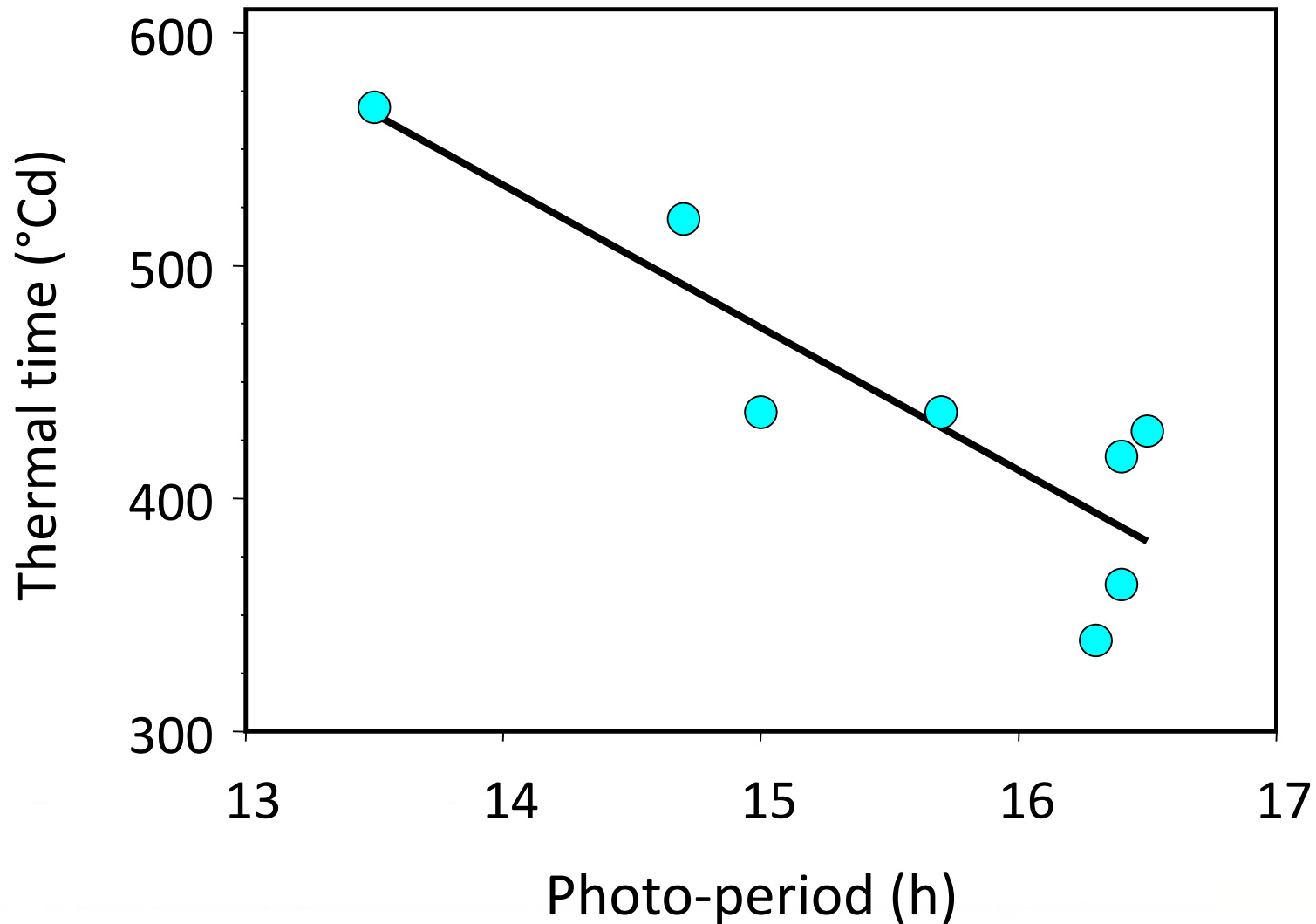
Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND



Stem height 60 cm

No flowers

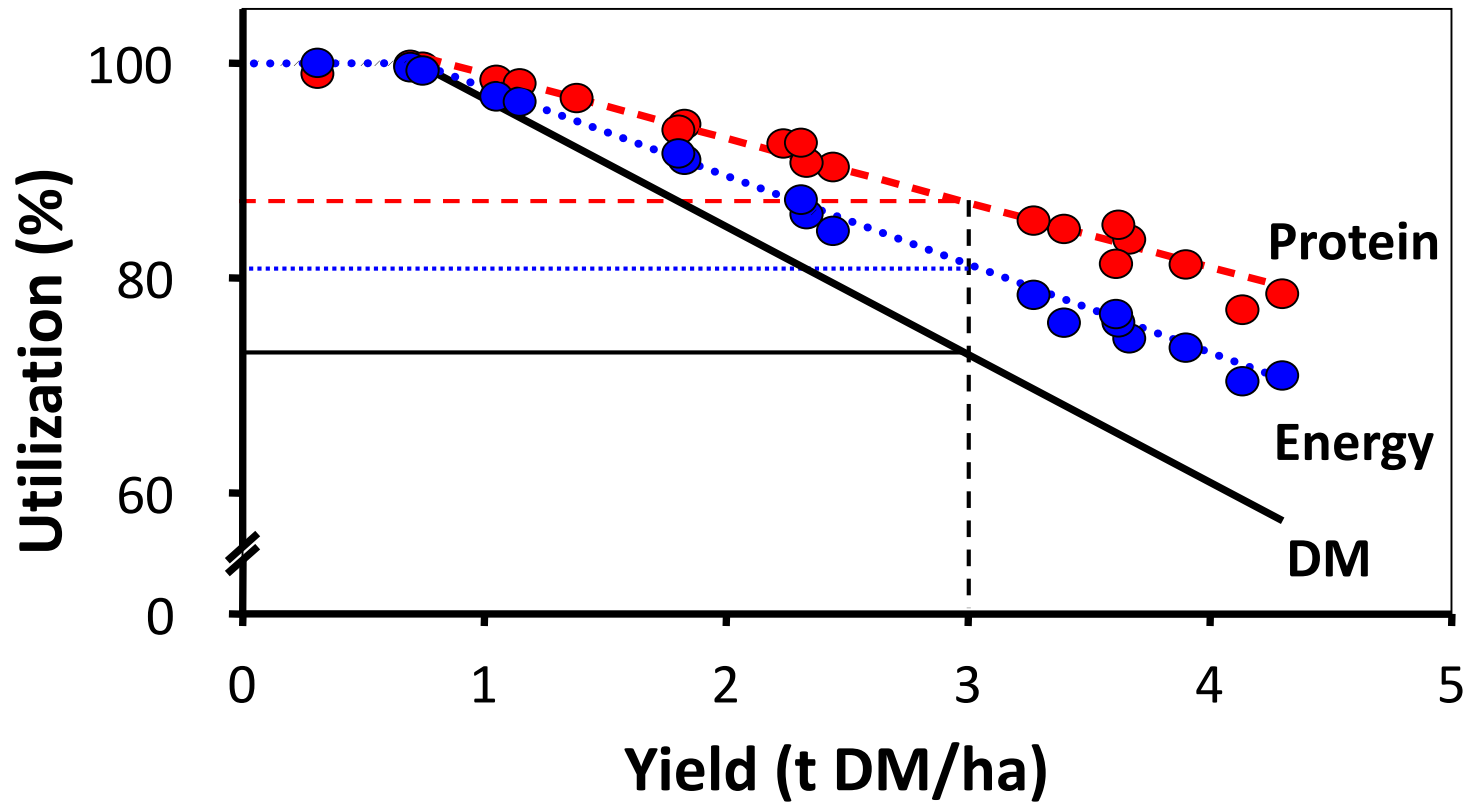
Thermal time to early-bud



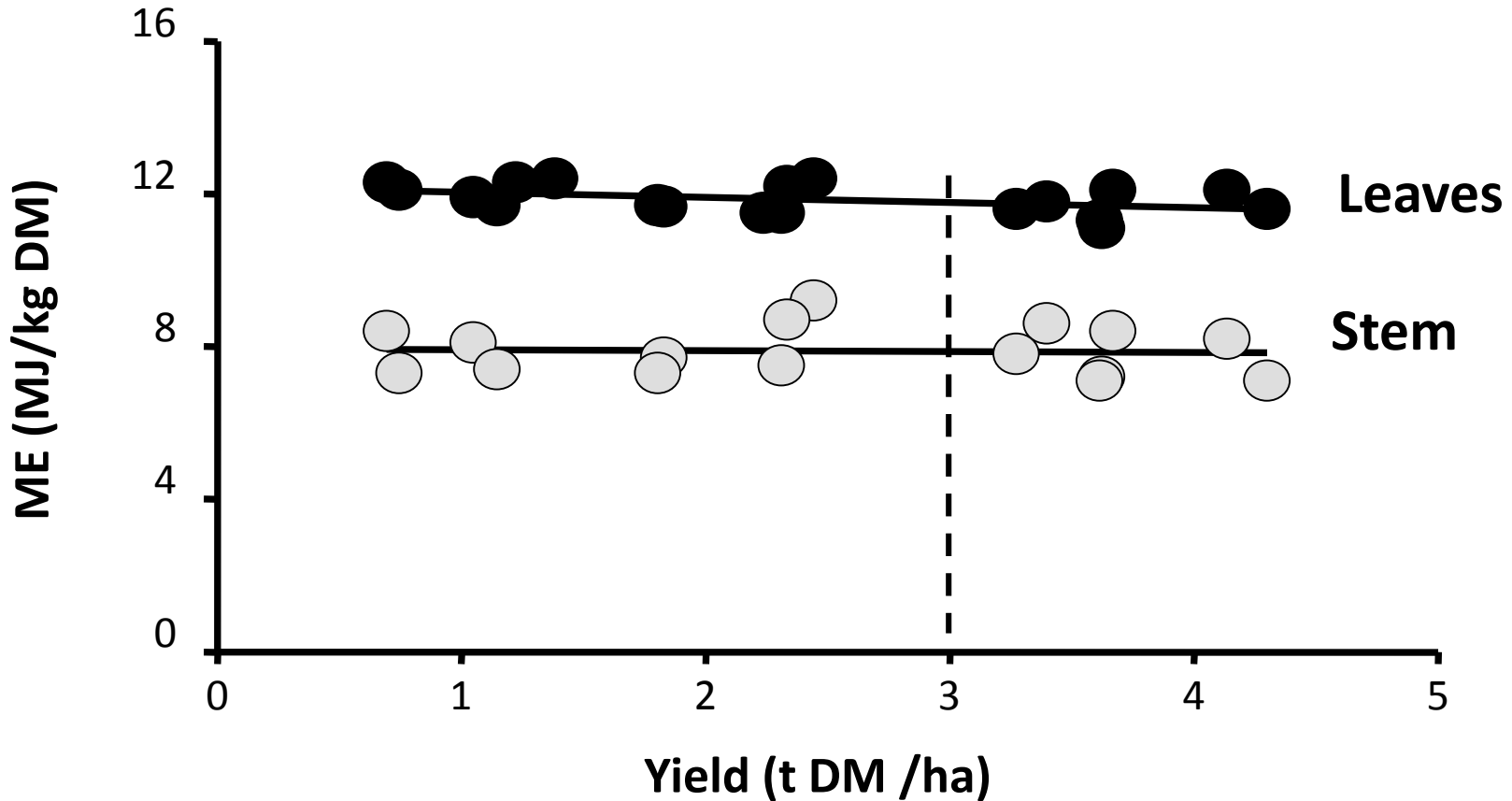
10% flowering; 60% stem



Utilization of alfalfa herbage

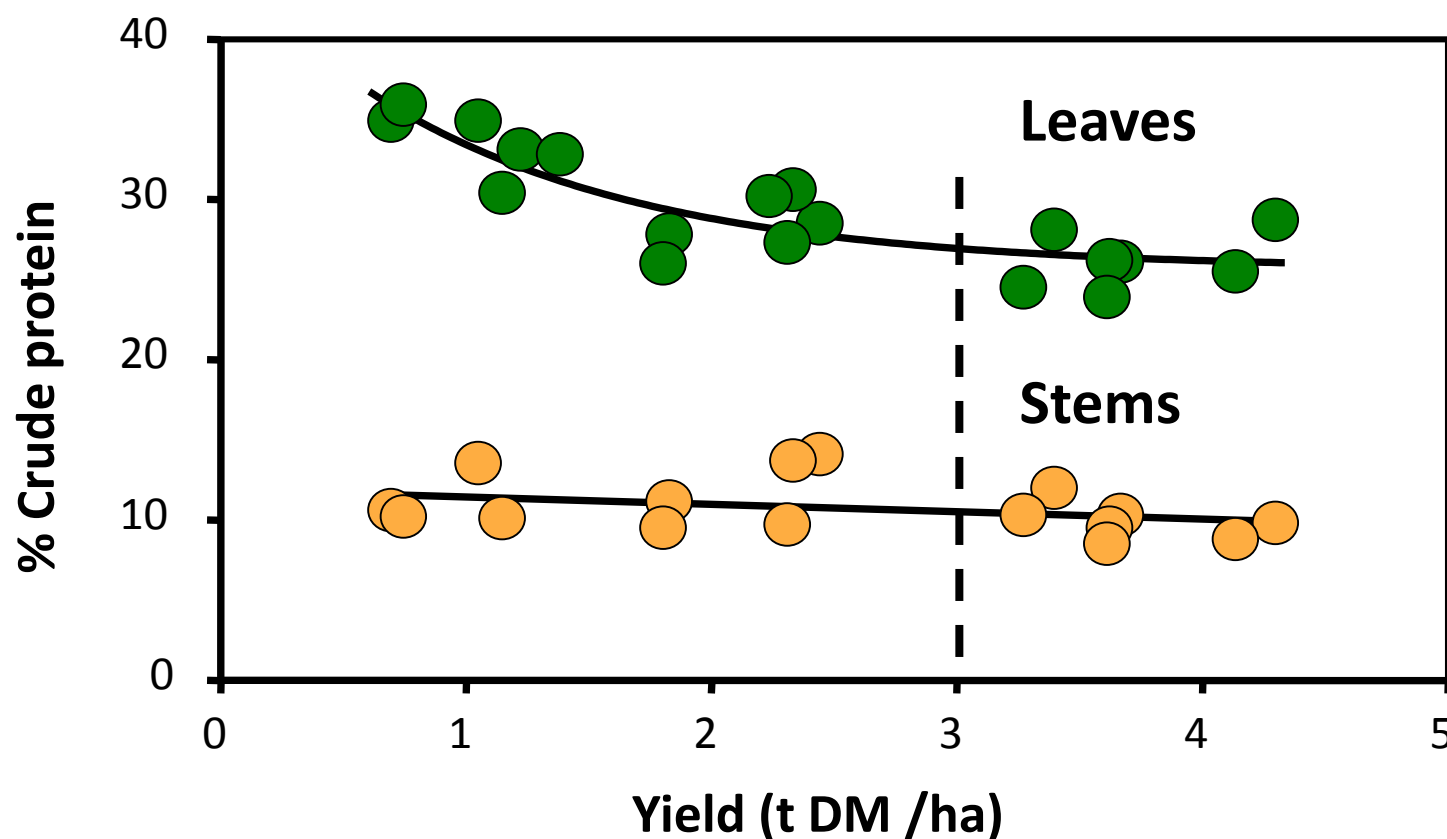


Metabolizable energy of alfalfa



New Zealand's specialist land-based university

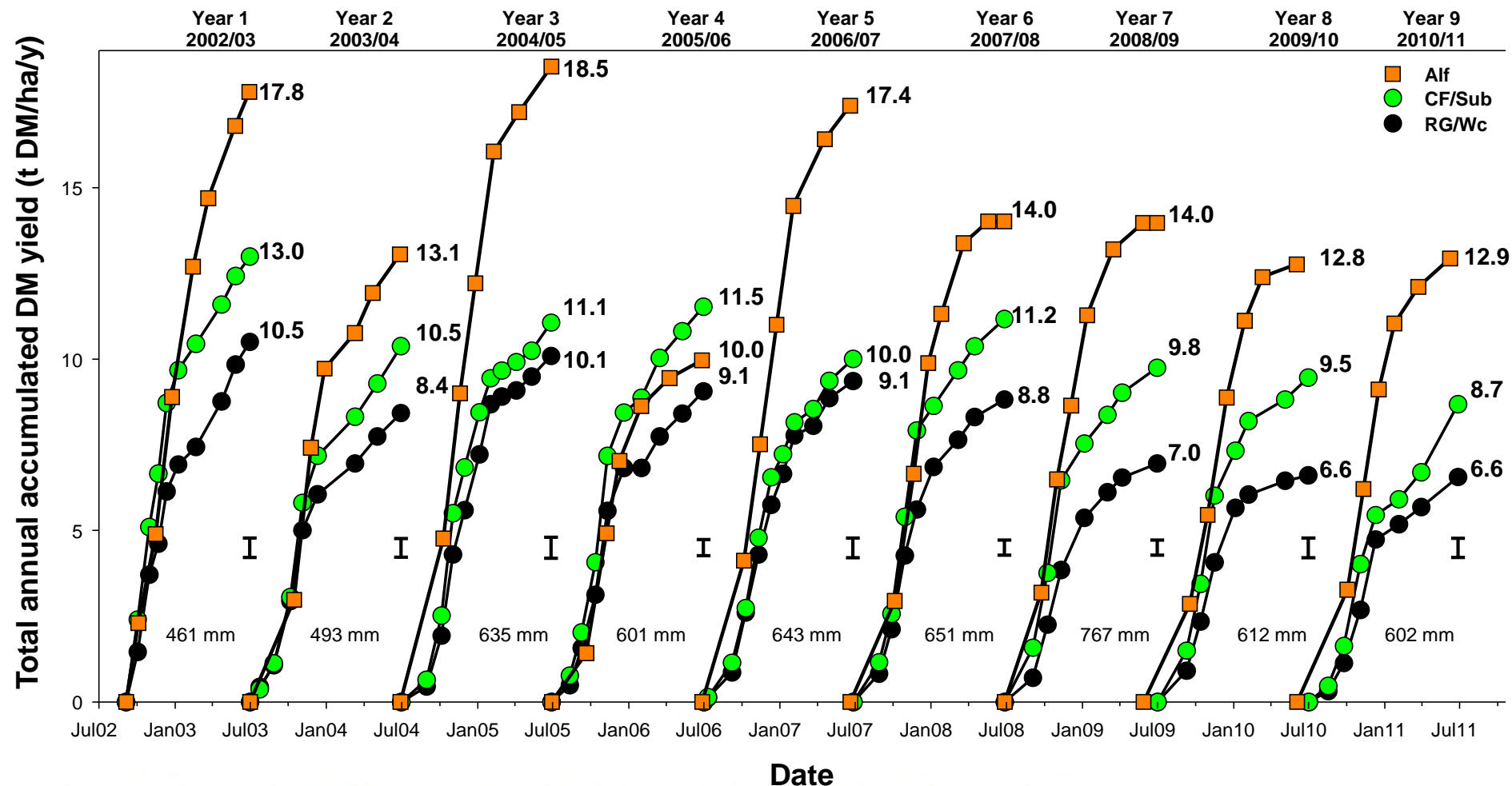
Crude protein of lucerne herbage



RG/Wc
Alfalfa
CF/Sub
CF/Balansa
CF/Cc
CF/Wc

' Grazing Expt. (3) - MaxClover'

MaxClover Total DM yields

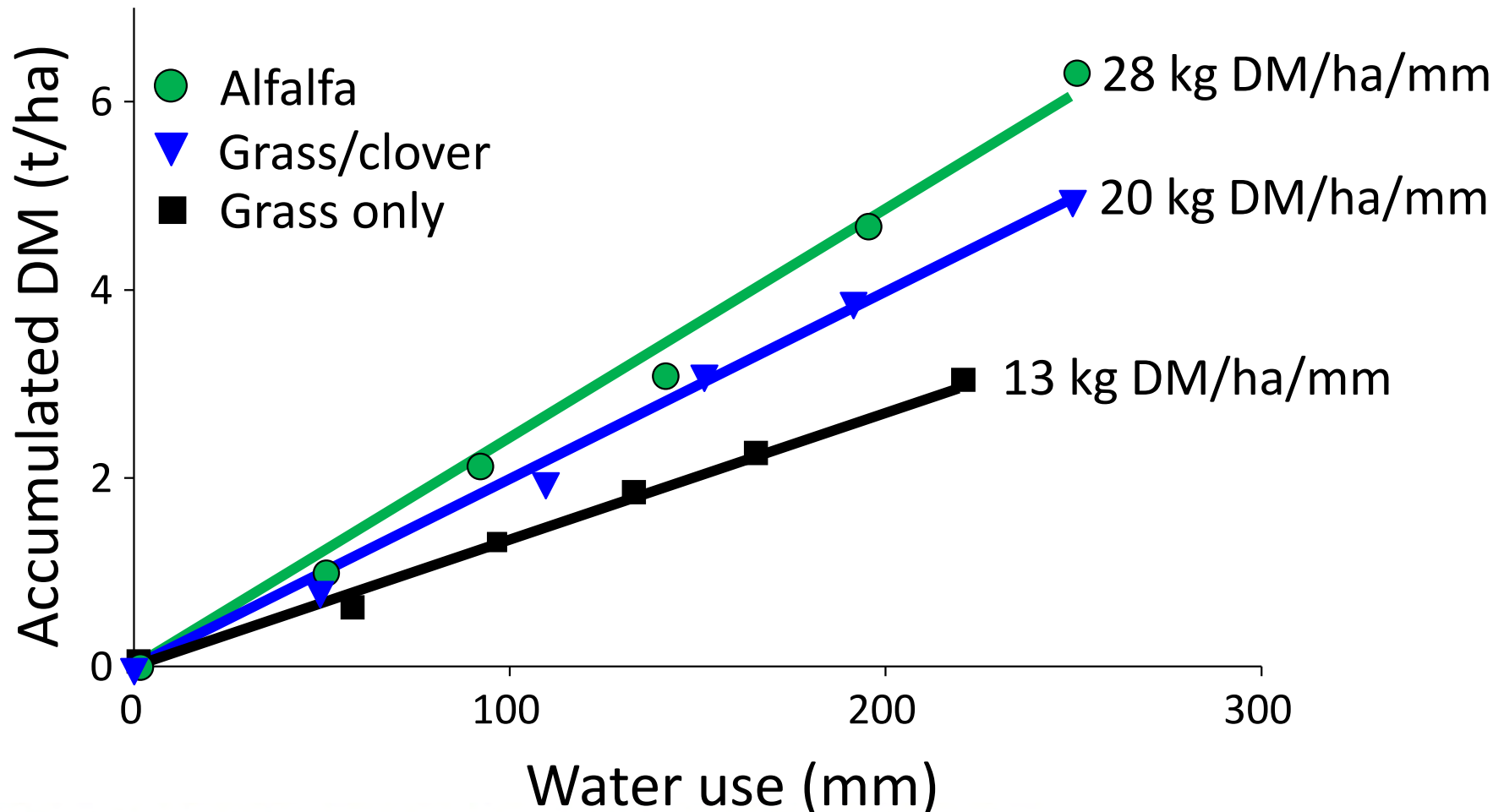


New Zealand's specialist land-based university



Unsown species <5% in Year 1>45% in Year 6
RG/Wc pastures

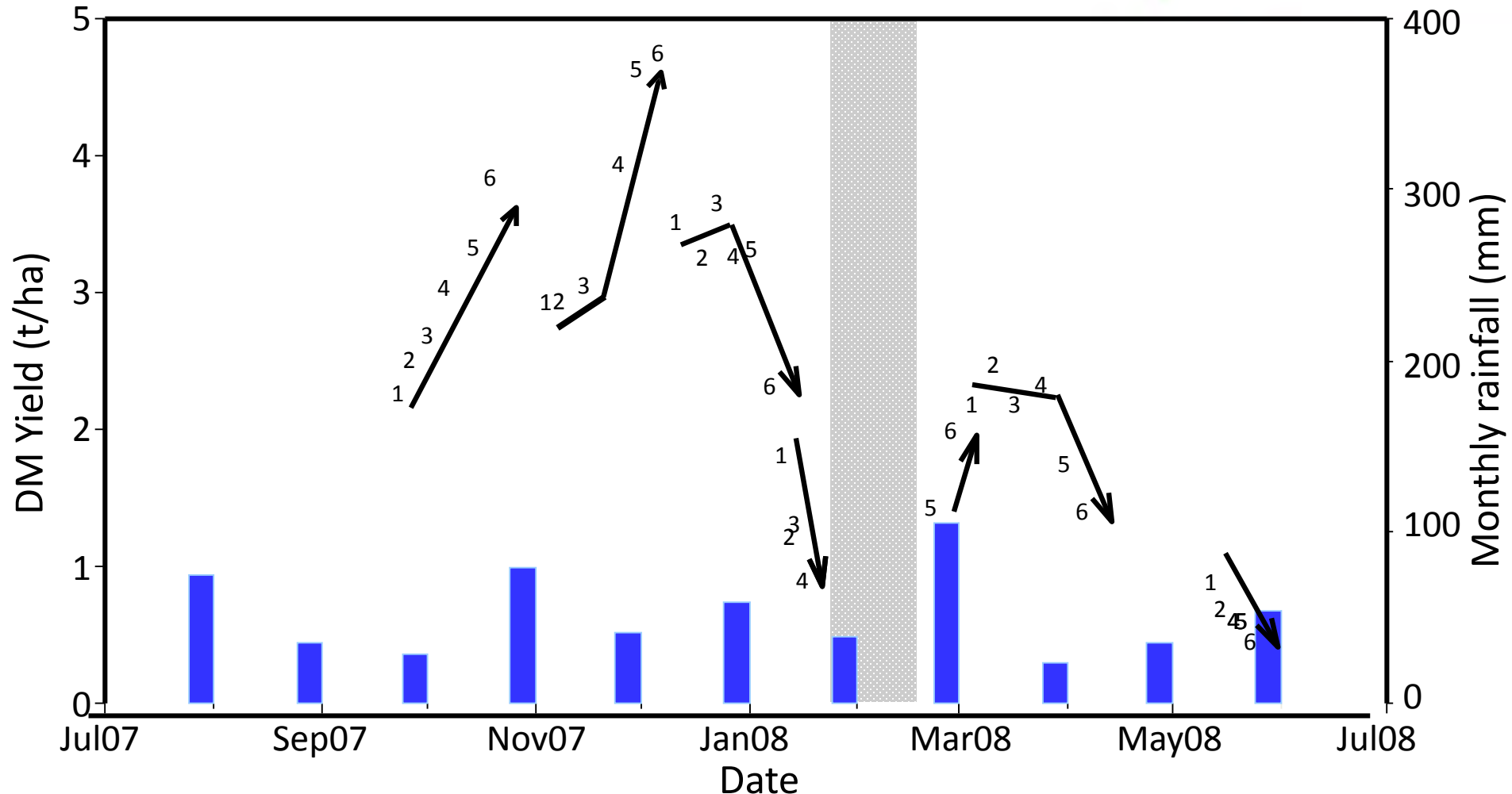
Spring WUE





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

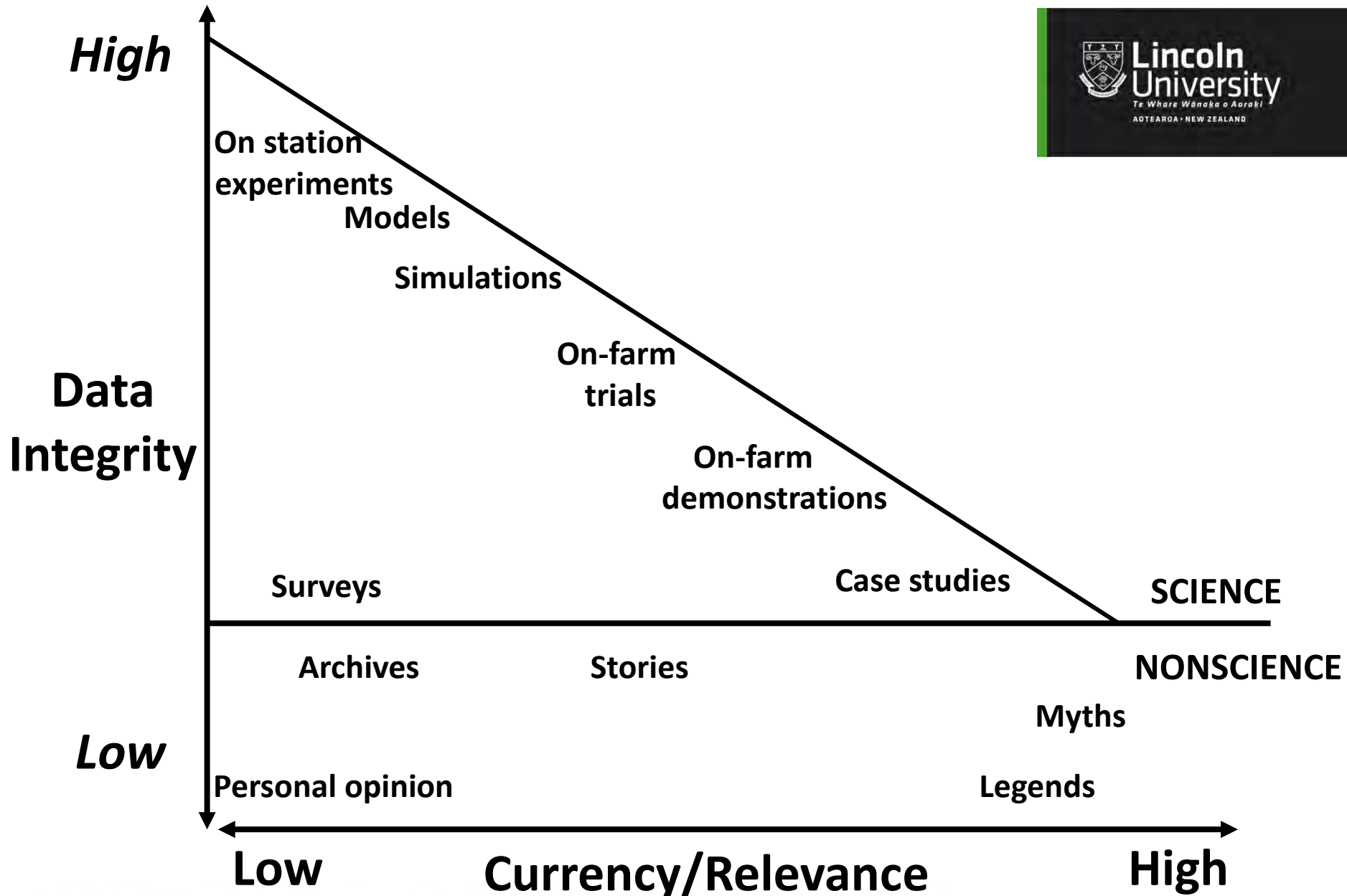
MaxClover – 38-42 day rotation



New Zealand's specialist land-based university

Alfalfa research outcomes

- 1) Identified alfalfa as the “dryland plant”
- 2) Understood the interactions of alfalfa and its biophysical environment
- 3) Validated science with independent data sets
- 4) Interpret the science for on-farm application



New Zealand's specialist land-based university

Extension – empower to succeed



SERVANT LEADER

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

Spring = animals





Photo: D Avery
'Bonavaree', Marlborough

Where to plant

New Zealand's specialist land-based university



When to graze



How to graze



How to manage water





Six paddock rotation on-farm demonstration



5th September 2011 – Cave Sth Canterbury



Photo: D Avey
'Bonavarec', Marlborough

11.09.2009
What else to feed

Alfalfa + *Dactylis*



Sheep health

- **Clostridial bacteria:** vaccinate
- **Cobalt:** vitamin B12 injection
- **Redgut:** problem on high quality feeds – fibre
- **Avoid flushing if:** leaf spots or flowering alfalfa
- new regrowth or tops only are O.K.

Which animals?



New Zealand's specialist land-based university

Dairy cows

Seasonal grazing management

Spring/summer (Nov-Jan)

- Priority is stock production (lamb/beef/deer)
- graze 6-8 weeks solely on alfalfa
- 5-6 paddock rotation stocked with one class of stock
(7-10 days on)



Deer = no bloat



With capsules

Cattle health

- **Bloat:** never hungry when shifted – capsules
- **Na def. (0.03%):** salt licks/fence-line weeds/pasture
- Require 0.11% Na - sheep/beef/dairy

Bloat

(this animal survived)



30/09/2014

Seasonal grazing management

Early autumn (Feb-April)

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

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

New Zealand's specialist land-based university

Autumn = flowering plants Oestrogens?



Rotation 4 Pre-graze
Plot 6 (28/2/08)
2.0 t DM/ha produced in 51 d

Talk to the farmers + agribusiness





In the field

Again



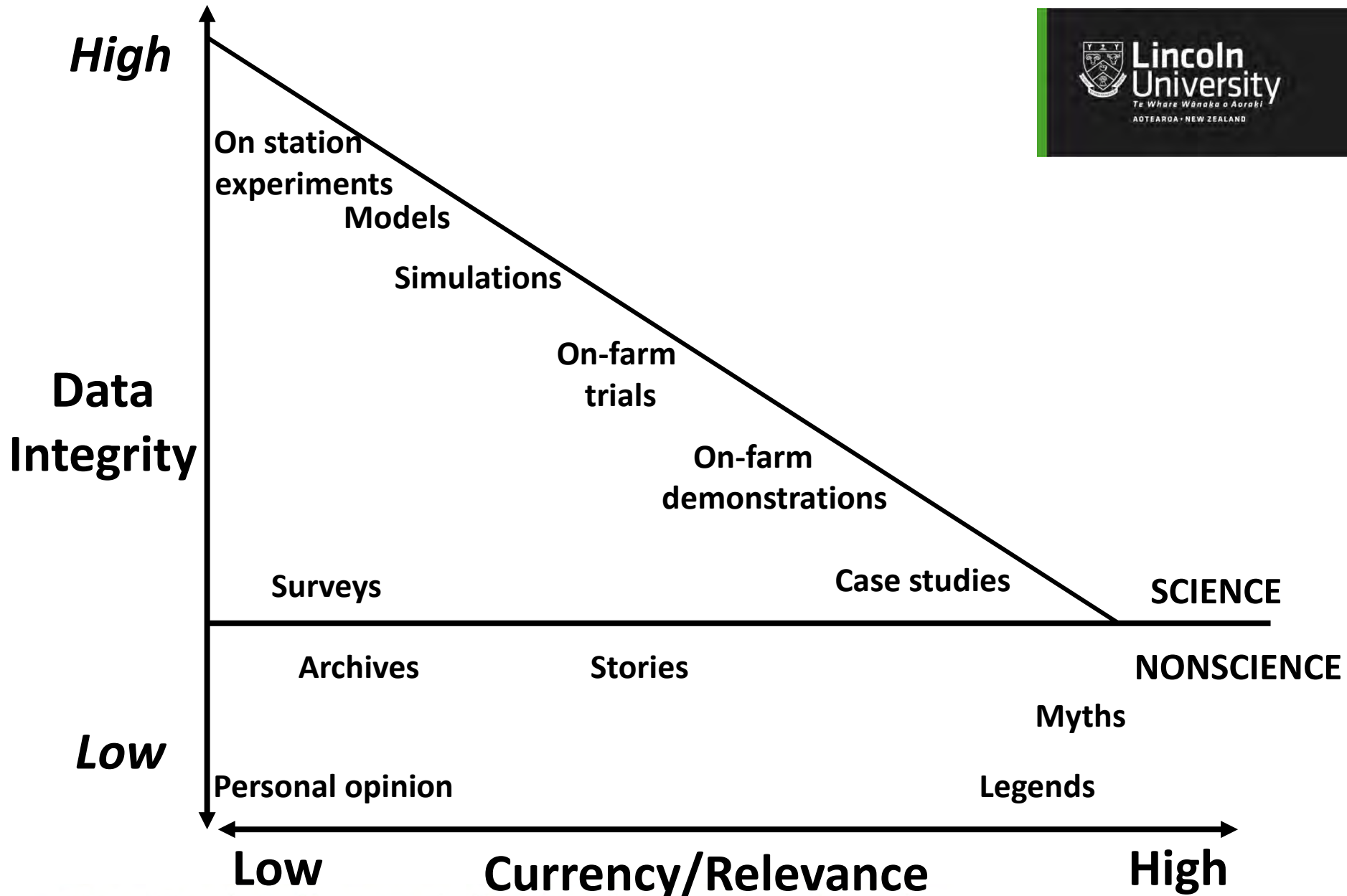
And again





157 Extension days since 2007

(to June 2014)



New Zealand's specialist land-based university

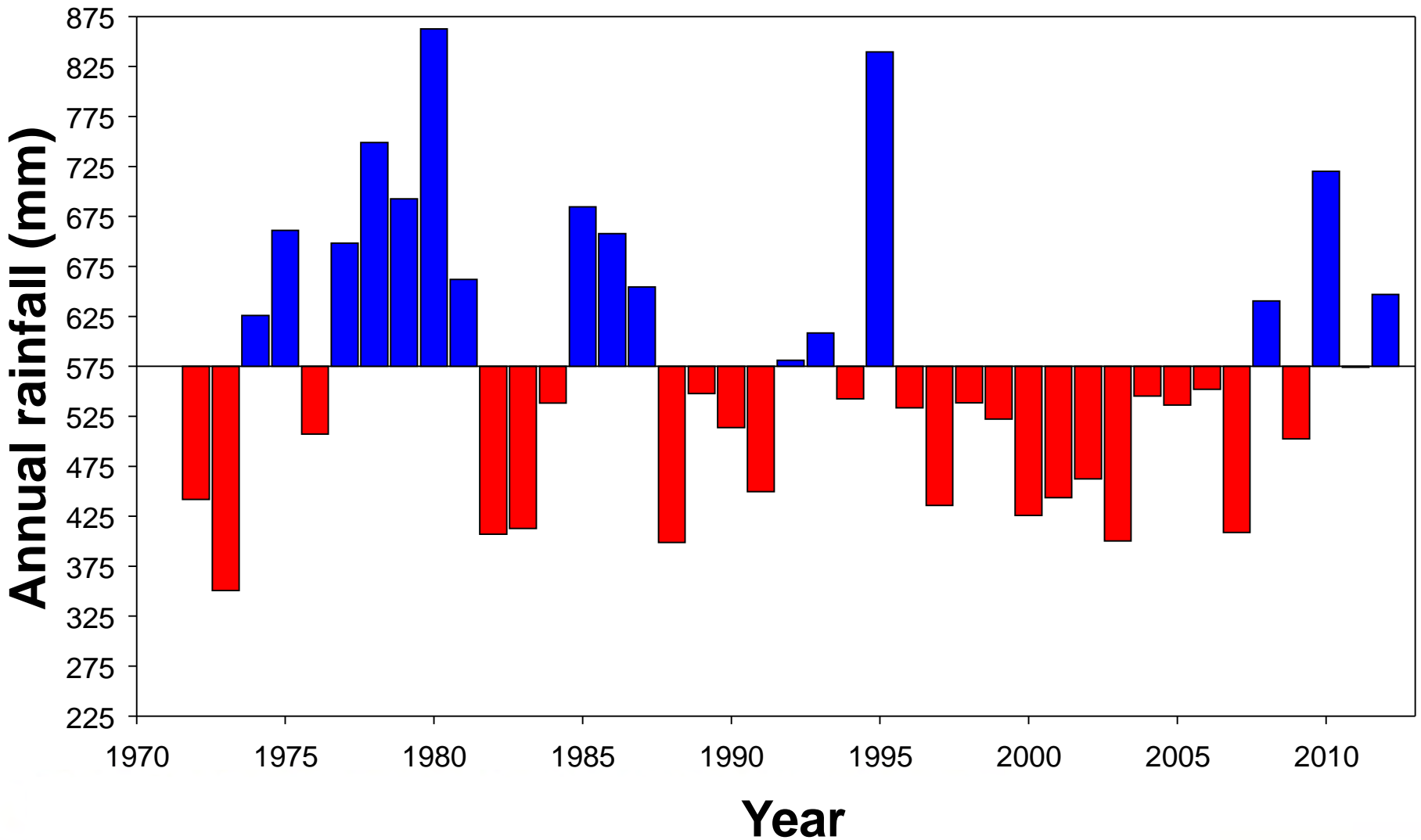
Case study – Bonavaree farm

Over grazed – high erosion risk



19/07/2004

Annual rainfall at 'Bonavaree'





Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND



Salt bush

Young alfalfa

Chemically fallowed land

'Bonavaree' production change over 10 years

	2002	2012	Change
Land area (ha)	1100	1800	↑ 64%
Sheep numbers	3724	4158	↑ 12%
Lambing (%)	117	145	↑ 24%
Lamb weights (kg)	13.3	19.6	↑ 43%
Lamb sold (kg)	38324	74460	↑ 94%
Wool (kg)	18317	20869	↑ 14%
Sheep:cattle	70:30	50:50	
Gross trading profit (ha)	\$500	\$1300	↑ 149%

2012 at 'Bonavaree'

Flooding in spring and annual rainfall slightly above the LTM
(4% cf. 1890-2001 period)

500 more lambs than ever before

– even with the wet spring (200 mm rain causing flooding)

Record lamb process weights (kg/hd)	19.6
-------------------------------------	------

Record bull beef weights	359 kg/hd
--------------------------	-----------

Record ewe weight at mating (+5 kg)	82 kg/hd
-------------------------------------	----------

Record ewe LWT gain during mating	+4 kg/hd
-----------------------------------	----------



Photo: D. Avery
© Homavate, Marlborough

New Zealand's specialist land-based university



10/10/2014

**Ewes & lambs graze lucerne at 'Bonavaree', Marlborough
Lambs approx. 6 weeks old**

Photo: D Avery



Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND



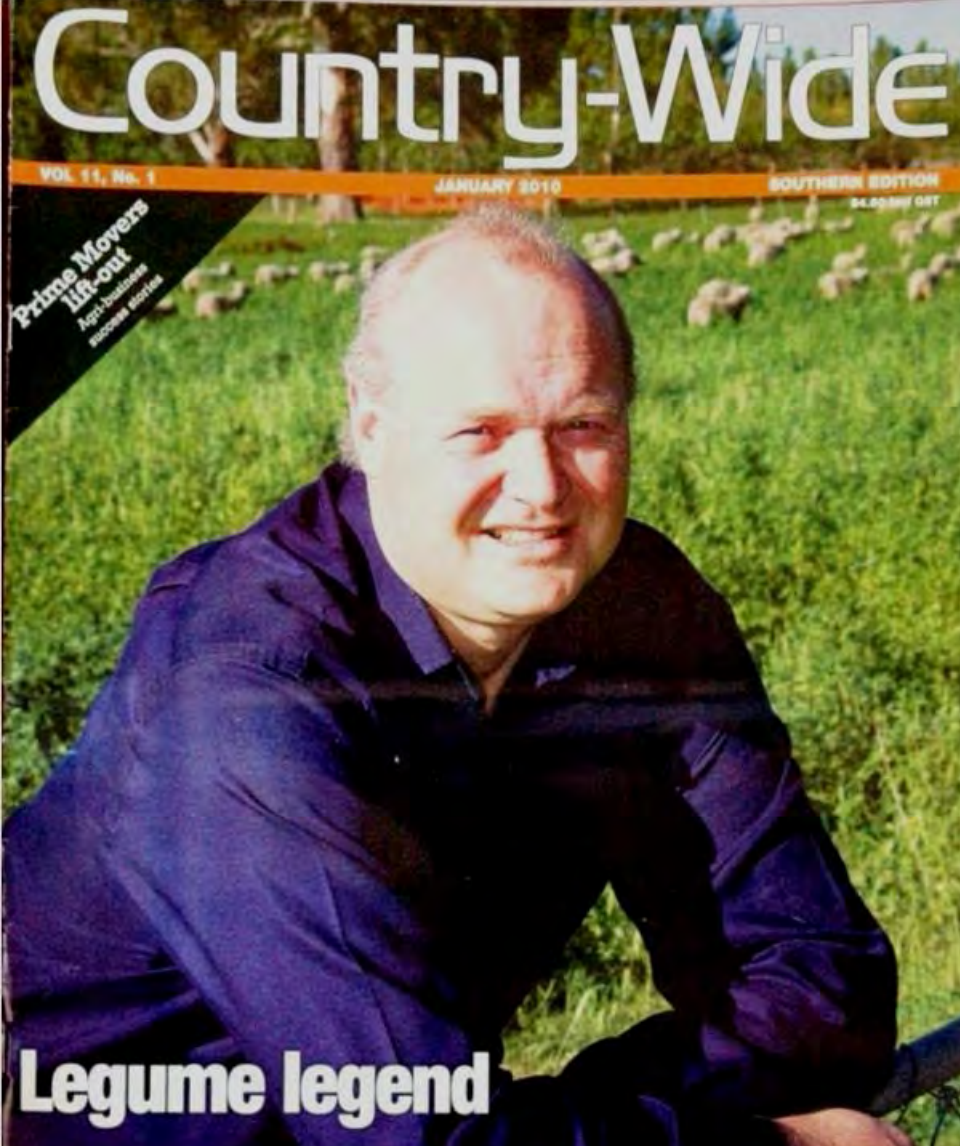
***“With better income we can focus on the environment and preserve it for generations to come”
(Doug Avery)***

New Zealand's specialist land-based university

Resilient drought-proofed landscape



SI Farmer of the Year 2010



Integrity & Trust

Transformational change & Resilience to climate change



Doubling of alfalfa seed sales over 10 years



“28-35% Internal rate of return on investment”



Bog Roy Station

New Zealand's specialist land-based university



2011 10 16

Landscape farming - ecosystems services



Bog Roy Station

New Zealand's specialist land-based university



You will fail

The Website...

www.lincoln.ac.nz/dryland

- On-farm activity diary
- Slide shows, photos & video
- Ability for farmers to comment/question/query
- Farmers and researchers can respond

BLNZ txt service

The Blog...

<http://www.lincoln.ac.nz/conversation/drylandpastures/>

Lincoln University
Te Whare Wānanga o Aoraki
CHRISTCHURCH - NEW ZEALAND

Dryland Pastures

Conversations at Lincoln University

Home | About | Blog

Lambing onto Omaka Barley - North Face

Posted on August 27, 2012 by Cath Coulter

Omaka Barley is a great crop to use at Bonavaree. Barley is used here because it really fits in well with the Avery's system. The Omaka variety has been bred locally, and is very suitable for reliable dry matter production in a Marlborough dryland environment.

It is a multipurpose crop at Bonavaree, in that it is used as a green feed crop, and as a break crop. The Omaka is grazed multiple times from March till the end of August. Dry matter production is usually between 6-8 T/ha, and is grazed by both cattle and sheep.

Omaka Barley is also used regularly at Bonavaree for the purpose of breaking weed/pest cycles, and increasing base soil fertility in preparation for sowing lucerne, or a Bonavaree mix. Barley is used as the 2nd break crop in a multi stage lucerne renovation system that has been working very well. The 1st break crop used is an Annual Ryegrass that is grazed by multiple bearing ewes at lambing, and prime bull beef production. We will be following the progress of this renovation system through, with regular updates.

Some paddocks are used to grow Omaka Barley for two consecutive years, but because of the Avery's wider interest in establishing paddocks with Lucerne, barley is normally used as a 2nd break crop in the renovation process.

Recent Posts

- ▶ Lambing onto Omaka Barley - North Face
- ▶ Lambing onto Lucerne - Jaffries Front Flat (August)
- ▶ Bonavaree Dryland Blog
- ▶ Welcome to dryland pastures blog

Recent Comments

- Cath Coulter on Bonavaree Dryland Blog
- Gavin snow Loxton on Bonavaree Dryland Blog
- Barbara Stuart on Bonavaree Dryland Blog

Archives

- ▶ August 2012

Categories

- ▶ Dryland Lucerne
- ▶ Uncategorized

Meta

- ▶ Log in
- ▶ Entries RSS
- ▶ Comments RSS

Dryland Research

1) Farmer survey (1998 – 1 Masters)

2) Directed Experiments (1998 - present):

31 PhD,

9 Masters,

24 Honours students



3) Science and Modeling (2000 – present)

50 international journal

120 conference proceedings



Sustainable transformation

- Farmers with *incentives to change* – economic, land sustainability, social
- Appropriate research – on-farm application to reduce complexity of intensification
- Mutual integrity and trust between scientist and farmers
- On-going engagement and mentoring



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.

Acknowledgements



New Zealand's specialist land-based university



Ministry of Agriculture and Forestry
Te Manatū Ahuwhenua, Ngāherehere

New Zealand's specialist land-based university

References & Links

Dryland Pastures Website: www.lincoln.ac.nz/dryland

Dryland Pastures Blog: <http://www.lincoln.ac.nz/conversation/drylandpastures/>

Lincoln University: www.lincoln.ac.nz

New Zealand Grassland Association: <http://www.grassland.org.nz/> (Open access publications)

- Anderson, D., Anderson, L., Moot, D. J. and Ogle, G. I. 2014. Integrating lucerne into a high country merino system. *Proceedings of the New Zealand Grassland Association*, **XX**, XXX-XXX (In Press). Online: PENDING (<http://www.grassland.org.nz/>)
- 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. Online: http://www.grassland.org.nz/publications/nzgrassland_publication_446.pdf
- Brown, H. E., Moot, D. J. and Pollock, K. M. 2005. Herbage production, persistence, nutritive characteristics and water use of perennial forages grown over 6 years on a Wakanui silt loam. *New Zealand Journal of Agricultural Research*, **48**, 423-429. Online: <http://www.tandfonline.com/doi/abs/10.1080/00288233.2005.9513677>
- Carberry, P. S. 2001. Are science rigour and industry relevance both achievable in participatory action research? In: B. Rowe, D. Donaghy, N. Mendham (Eds.). "Science and Technology: Delivering Results for Agriculture?". Proceedings of the 10th Australian Agronomy Conference, January 2001, . 29 Jan - 1 Feb 2001, Hobart, Tasmania. Australian Agronomy Society. p Online: <http://www.regional.org.au/au/asa/2001/plenary/2005/carberry.htm#TopOfPage>.
- 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. Online: http://www.grassland.org.nz/publications/nzgrassland_publication_32.pdf
- Moot, D. J. and Avery, D. 2013. Sustainable intensification of livestock grazing systems in low rainfall regions of New Zealand. In: First International Conference on Global Food Security, 29 September - 2 October 2013, Noordwijkerhout, The Netherlands. Elsevier Ltd. p O3.O3 (4 pgs).
- 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. Online: http://www.grassland.org.nz/publications/nzgrassland_publication_1654.pdf
- Moot, D. J. and Smith, M. 2011. Practical Lucerne Management Guide. 9 pp. <http://www.lincoln.ac.nz/Documents/Dryland-Pasture-Research/presentations/Lucerne-management-guide-Col.pdf>.
- NIWA. 2013. CliFlo Database - National Climate database. Date Accessed: 31/08/10. <http://cliflo.niwa.co.nz/>. Last Updated: Not Specified.
- NIWA. 2010. National Median Rainfall Map. Date Accessed: 31/08/10. <https://www.niwa.co.nz/climate/national-and-regional-climate-maps/national>. Last Updated: Not Specified.
- Salinger, J. 2003. Climate reality - actual and expected. In: D. J. Moot (ed). Legumes for Dryland Pastures. Proceedings of a Symposium held at Lincoln University, 18-19 November 2003. Grassland Research and Practice Series No. 11. Wellington: New Zealand Grassland Association, 13-18. Online: http://www.grassland.org.nz/publications/nzgrassland_publication_1678.pdf
- Teixeira, E. I. 2006. Understanding growth and development of lucerne (*Medicago sativa* L.) crops with contrasting levels of perennial reserves. Ph.D. thesis, Lincoln University, Lincoln, Canterbury. 274 pp. Online: <http://hdl.handle.net/10182/1471>.
- Teixeira, E. I., Brown, H. E., Meenken, E. D. and Moot, D. J. 2011. Growth and phenological development patterns differ between seedling and regrowth lucerne crops (*Medicago sativa* L.). *European Journal of Agronomy*, **35**, 47-55. Online: <http://www.sciencedirect.com/science/article/pii/S1161030111000293>
- Teixeira, E. I., Moot, D. J. and Brown, H. E. 2009. Modelling seasonality of dry matter partitioning and root maintenance respiration in lucerne (*Medicago sativa* L.) crops. *Crop and Pasture Science*, **60**, 778-784. Online: <http://www.publish.csiro.au/paper/CP08409.htm>