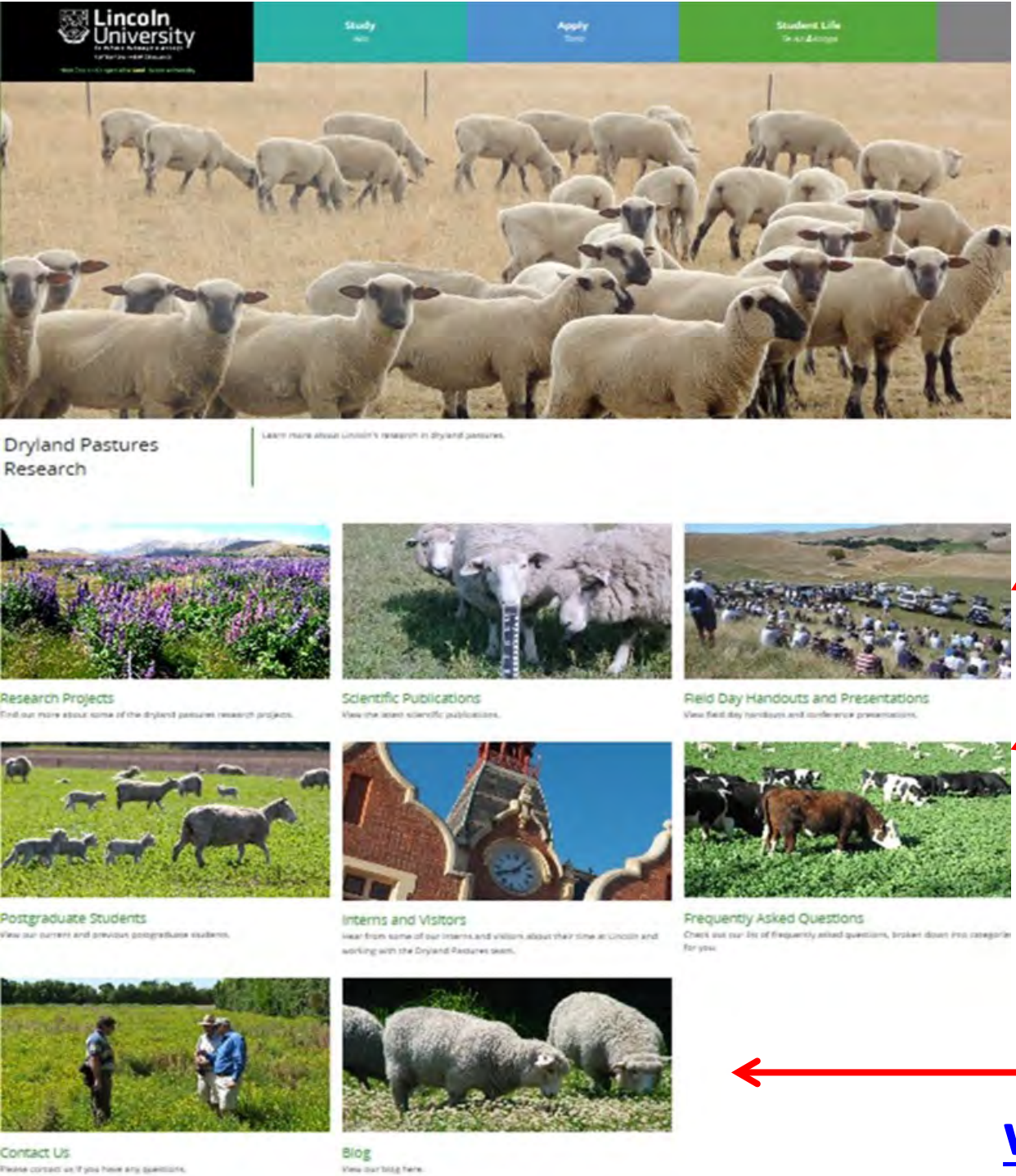
Windwhistle
19th November 2014

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH·NEW ZEALAND

Lucerne
Agronomy

Dr Derrick Moot
Professor of Plant Science



Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH•NEW ZEALAND

New look website
Handouts & presentations

FAQs

Direct link to Blog

www.lincoln.ac.nz/dryland

Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

Dry matter yield and botanical composition of the 'MaxClover' grazing experiment at Lincoln University, Canterbury, New Zealand

PHOTO DIARY - 2002/03 to 2010/11

Prepared by: DJ Moot; A Mills; RJ Lucas; KM Pollock; M Smith
Lincoln University Dryland Pastures Research Team

Funded by:
beef+lamb new zealand

New Zealand's specialist land-based university

General information

The ‘MaxClover’ Grazing Experiment was established at Lincoln University, Canterbury in Feb 2002.

There were six paddocks of each of the six pasture types. This gave 36 individual plots of 0.05 ha each.

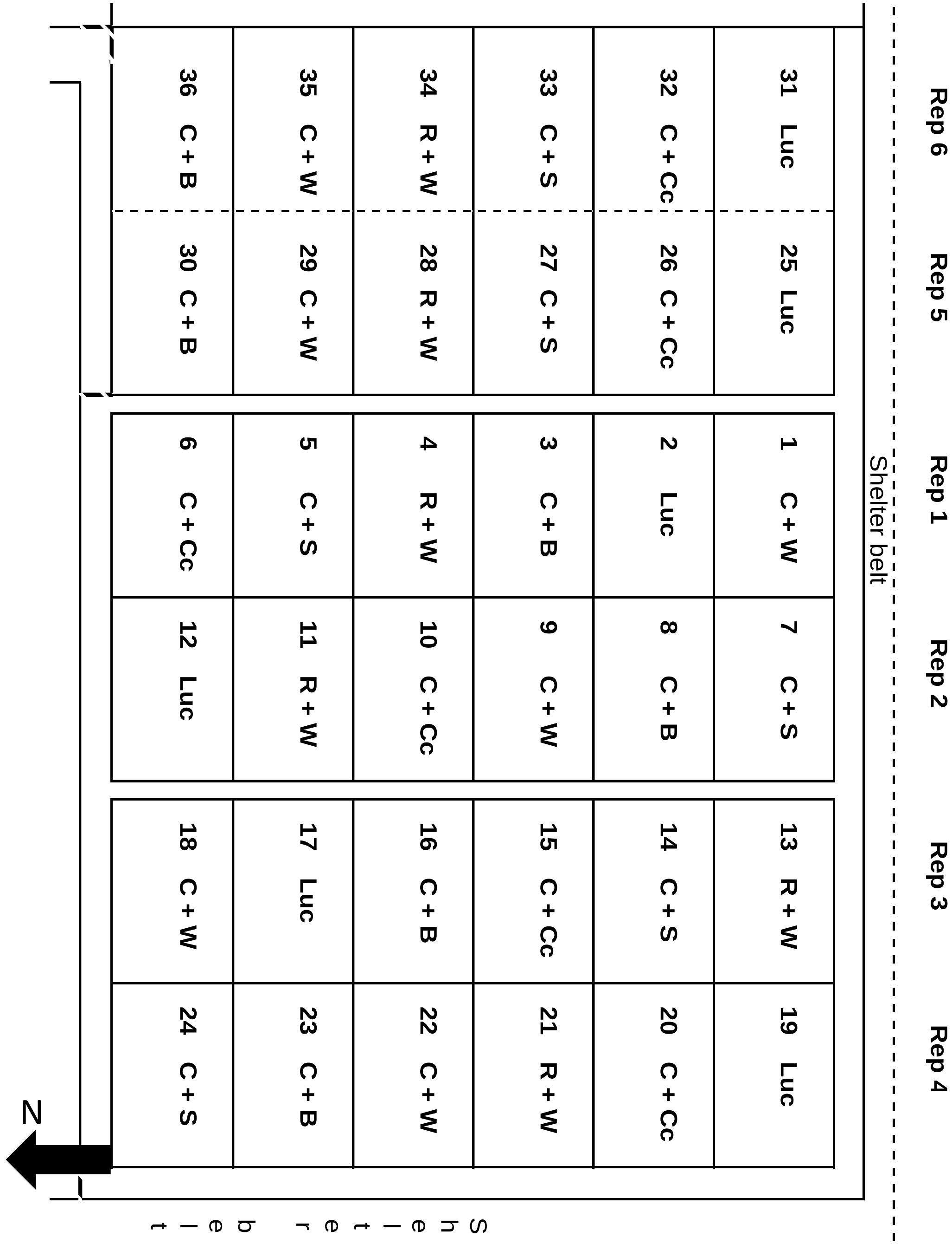
Measurements of yield and botanical composition began in Sept 2002 and continued until June 2011.

No nitrogen fertiliser or irrigation was applied to any pasture over the nine years. Other nutrients (S, P) and lime were applied in response to annual soil tests.

Annual soil test results can be found on the ‘MaxClover’ page at www.lincoln.ac.nz/dryland

No irrigation was applied. Annual rainfall ranged from 490 to 770 mm and the mean is about 630 mm/yr at this location.

Rainfall is variable and unpredictable, particularly from September to March when potential evapotranspiration exceeds rainfall leading to the development of soil moisture deficits.



Dryland
4 clovers + cocksfoot
v R/W v Luc
(Reps 1 - 4 sown Feb, 2002)
(Reps 5 & 6 sown autumn, 2003)

Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

B Bolta balansa clover (3.5 kg/ha)
C Vision cocksfoot (4kg/ha, reps 1-4) (2kg/ha, reps 5 & 6)
Cc Endura caucasian clover (5.9 kg/ha)
Luc Kaituna lucerne (5.7 kg/ha)
R Aries AR1 ryegrass (10 kg/ha)
S Denmark sub clover (10 kg/ha)
W Demand white clover (3 kg/ha)

Plot sizes

Dimensions	Area
22 x 23m	0.05 ha

Notes:
Plot numbers (1-36) are indicated for each plot.

The plan (not to scale) has been rotated so it has the same orientation as the aerial photo on the next page.

The ‘MaxClover’ Grazing experiment in paddock H19 at Lincoln University

Grazing management

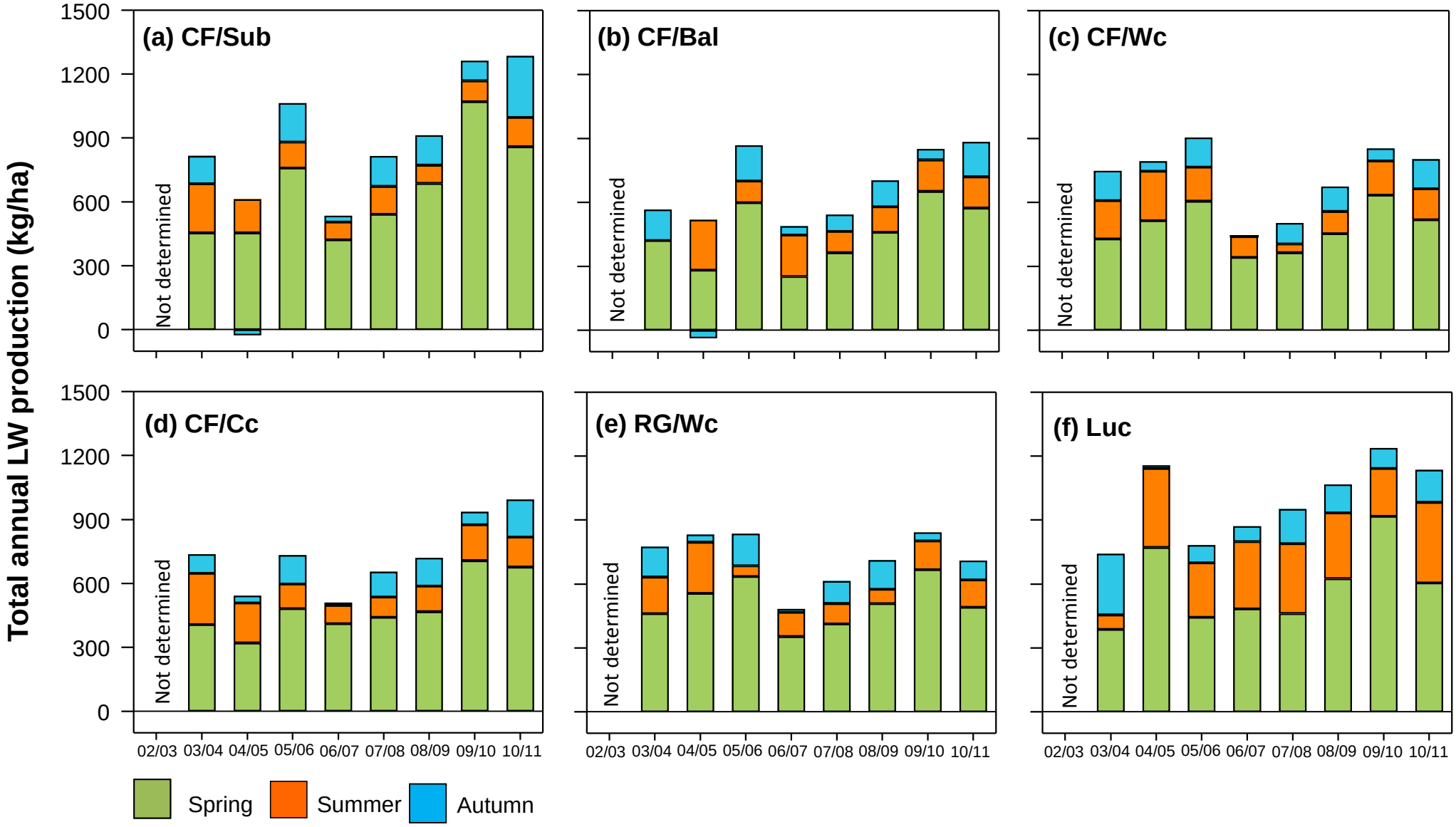
Lucerne was always rotationally grazed.

Grass-based pastures underwent a period of set stocking, short (2-paddock) or intermediate (3-paddock) rotational grazing in early spring before being rotationally grazed in a six paddock rotation until insufficient feed supply led to destocking of the pastures (drought or low winter temperatures).

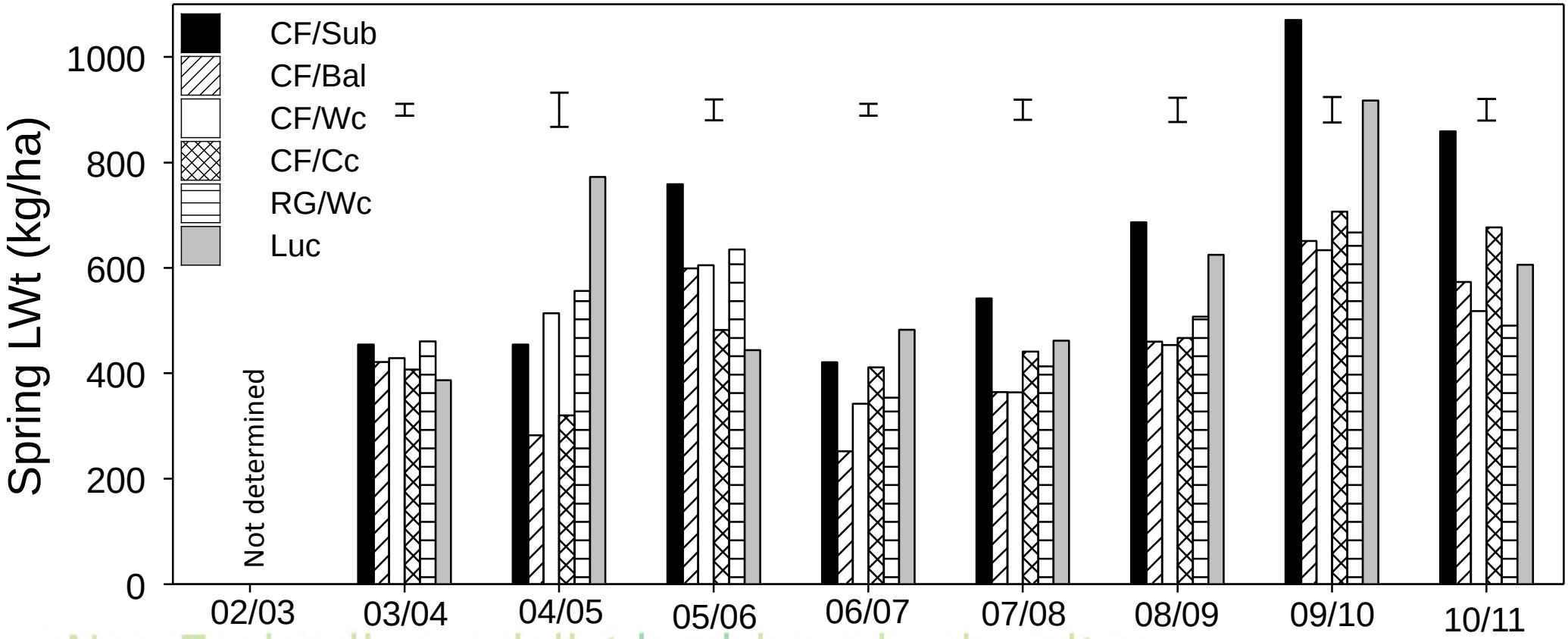
Pastures were generally destocked in winter when there was insufficient feed. This simulated a commercial farm system when sheep would be removed to graze winter forage crops or a smaller area of the farm set aside for winter grazing.

For pastures with annual clovers (sub or balansa) stock were removed to allow re-seeding. The timing differed as pastures were closed sequentially as the rotation progressed.

When necessary, ewes were used to hard graze annual clover pastures in early autumn to open the sward in preparation for the germination of annual clover seedlings after autumn rains.

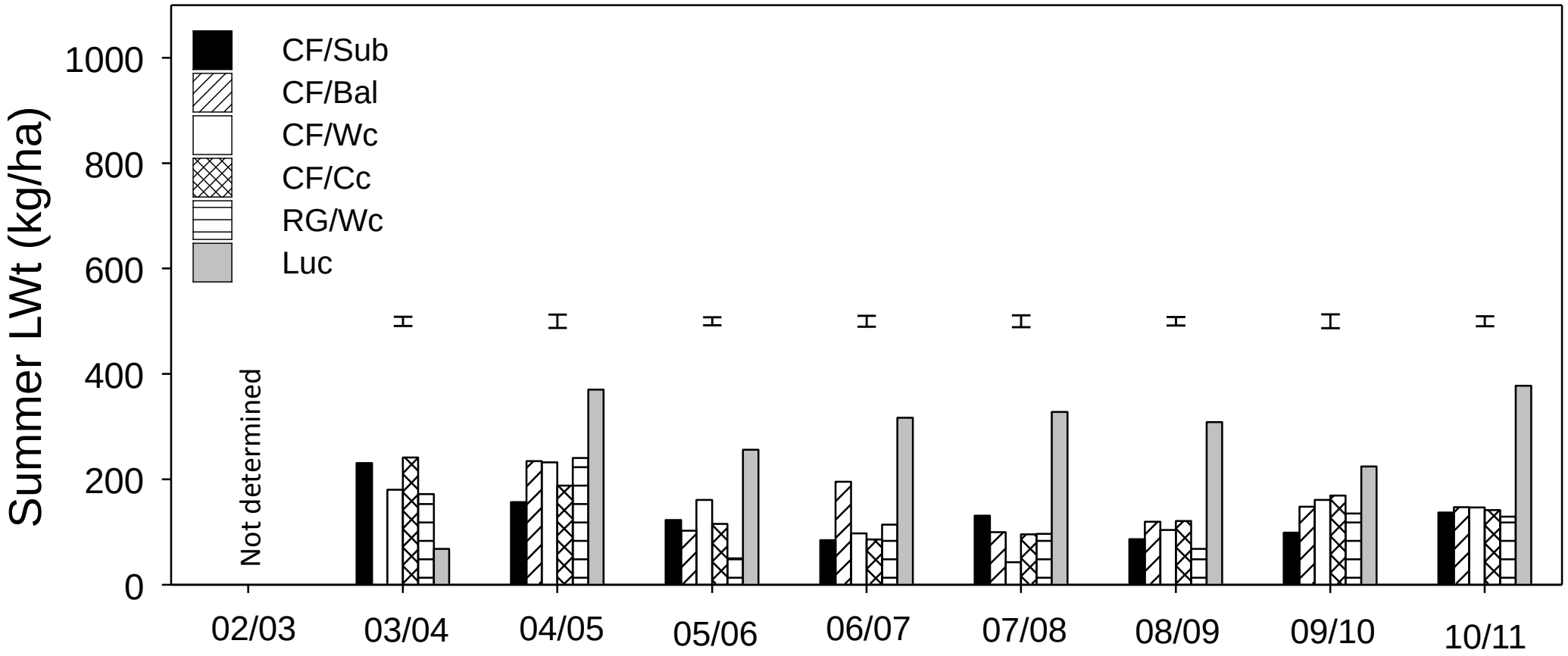


Total spring LWt production



Mills *et al*. 2014b

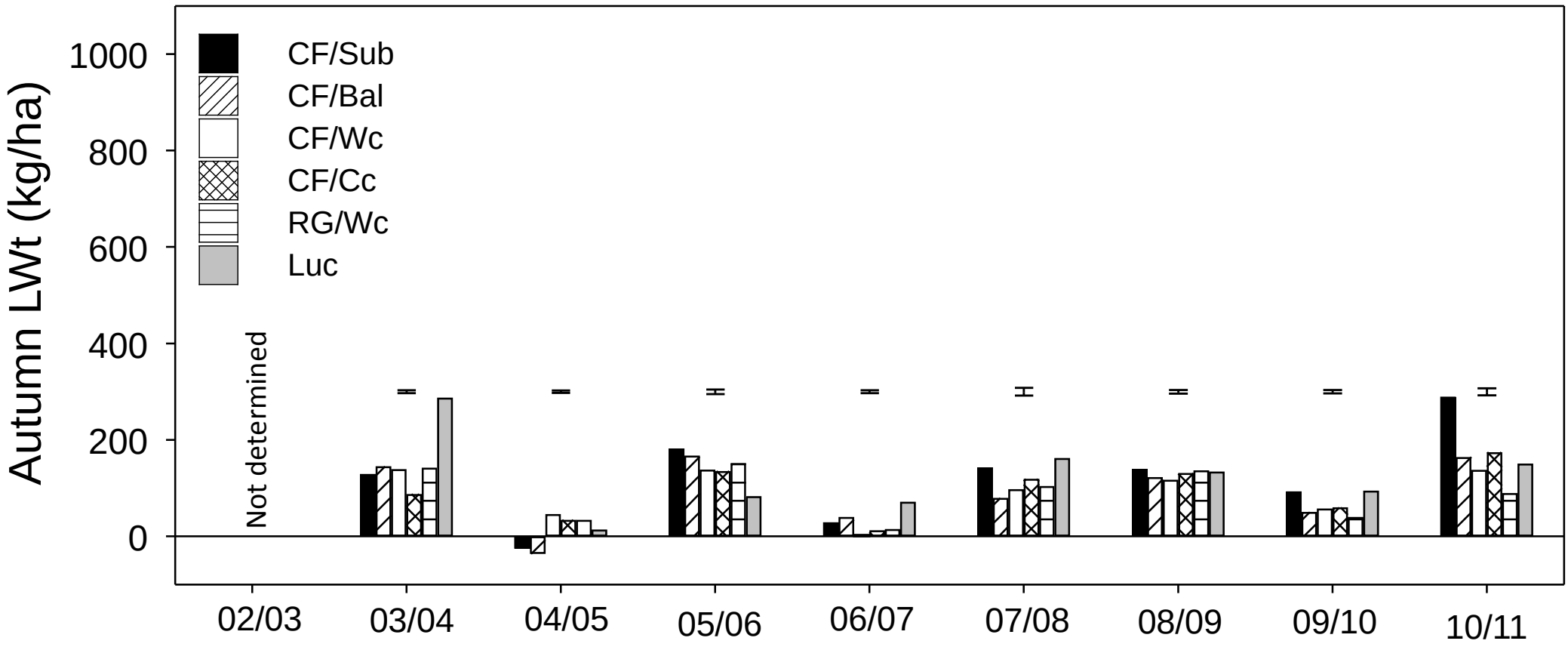
Total summer LWt production



New Zealand's specialist land-based university

Mills *et al*. 2014b

Total autumn LWt production

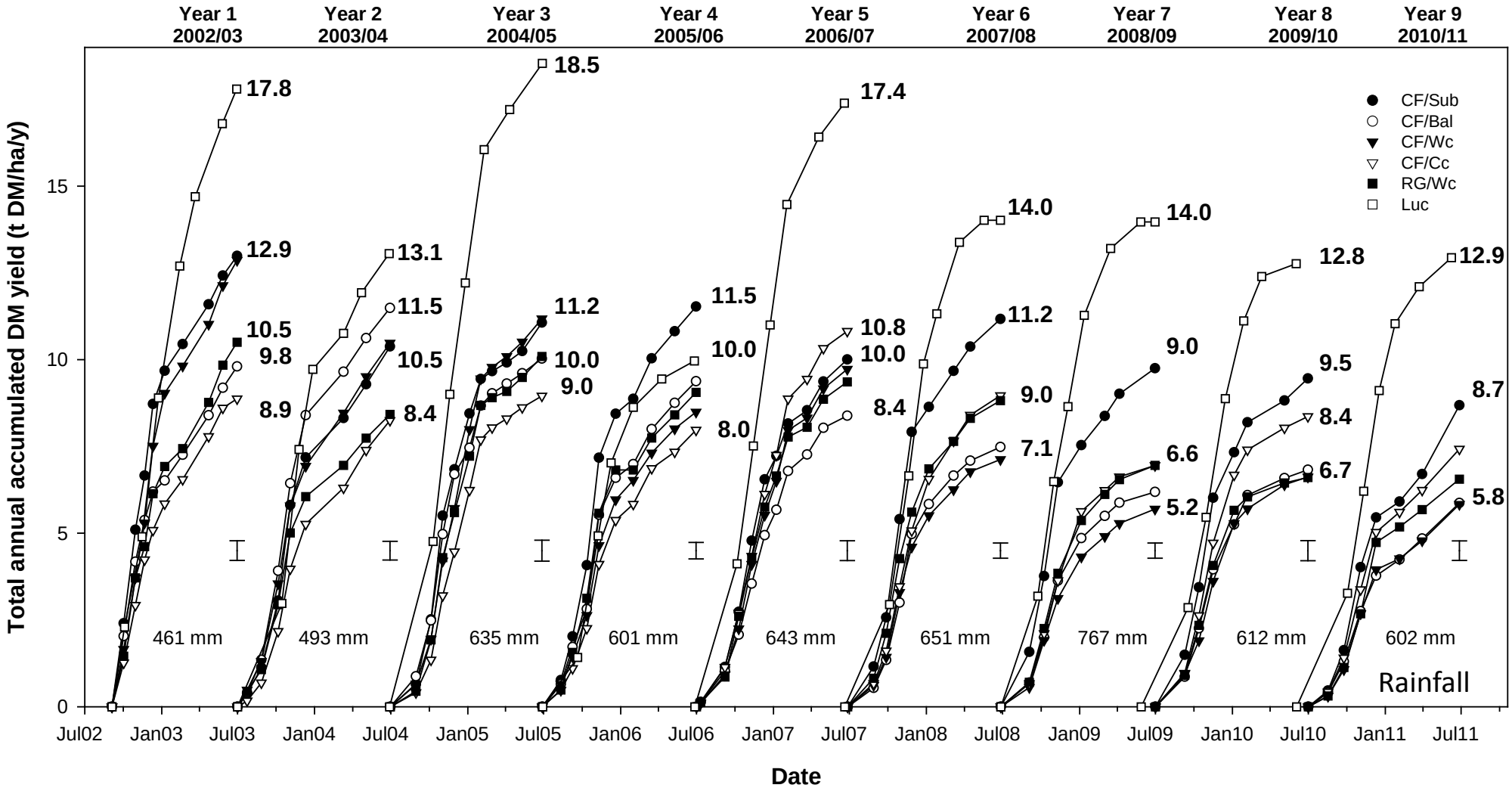


Yield and composition of six dryland pastures over nine growth seasons

- Lucerne produced more DM than all grass based pastures in most years.
- Its tap-root enabled access to water from lower soil layers but it also used water more efficiently than the grass based pastures - especially in spring.
- CF/Sub clover was the highest yielding grass based pastures in Years 6-9.
- Yields of all pastures declined over time.

Mills *et al*. 2014a

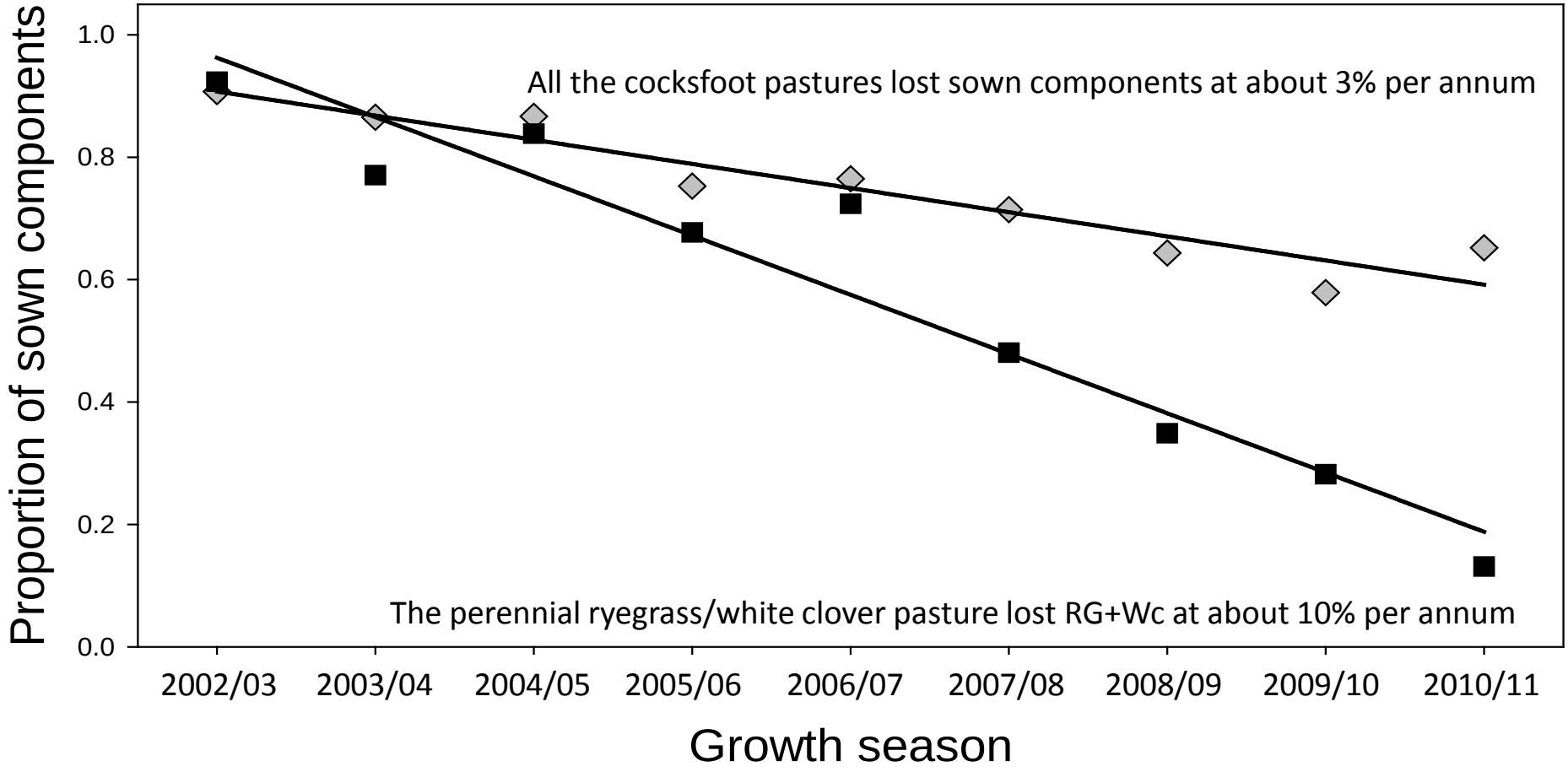
Figure 1. Total annual accumulated dry matter production



Summary of yields in Figure 1

- RG/Wc yield declined from 10.5 to 6.6 t/ha in Year 9.
- Lucerne yield was over 17 t/ha in 3 years and 12.9 t/ha in Year 9.
- CF/Sub yield declined from 12 t/ha to 8.7 t/ha in Year 9.
- CF/Wc, CF/Cc, CF/Bal yields were lower than CF/Sub in most years.

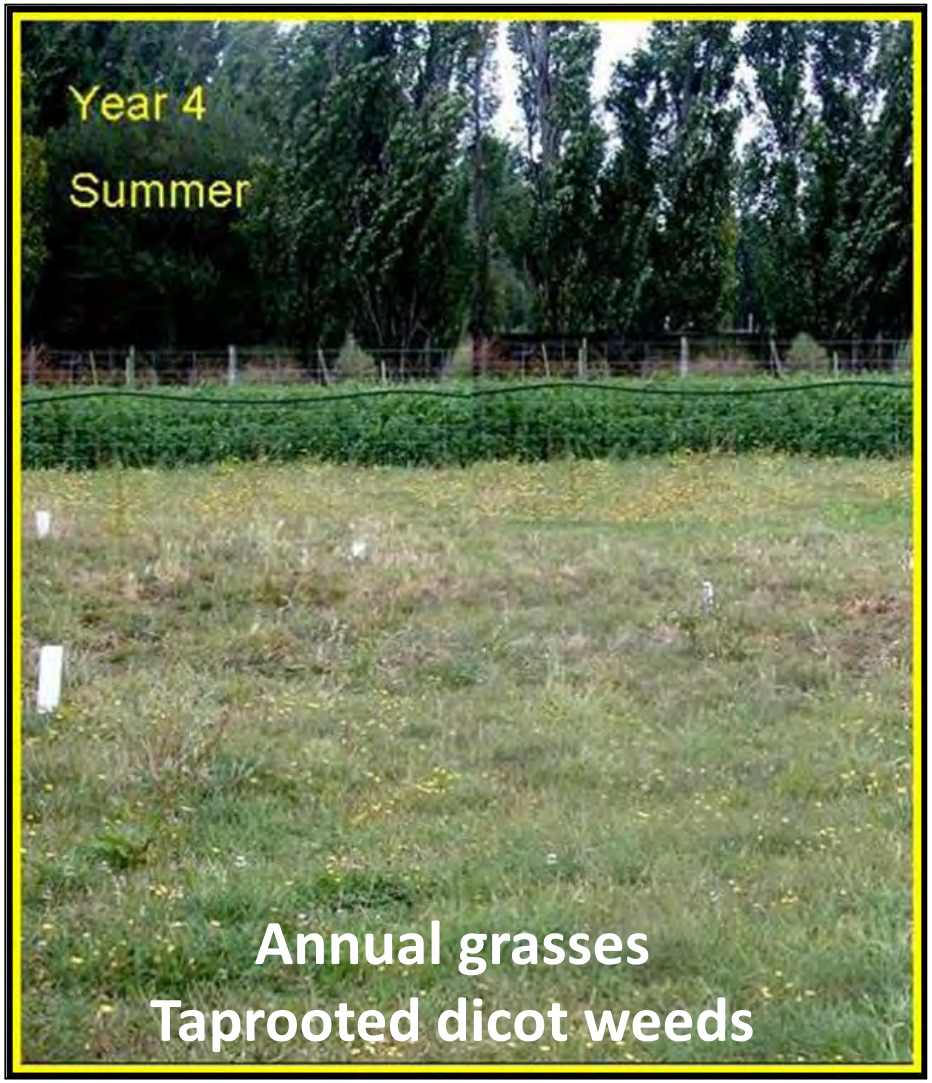
Figure 2. Change in the proportion of originally sown pasture components (grass + clover) over time



Mills *et al.*, 2014a

Summary of Figure 2

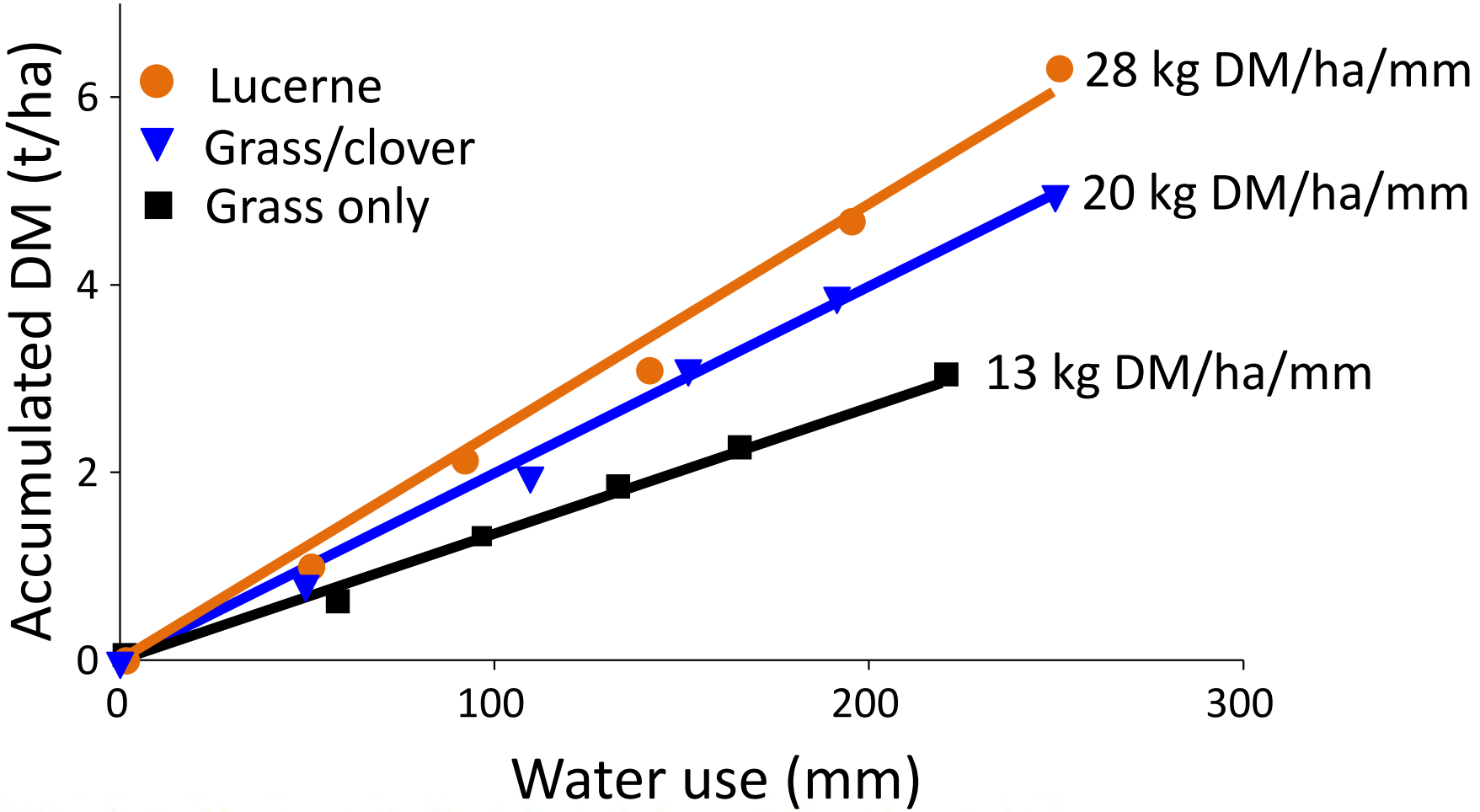
- After 9 years about 10% of the RG/Wc pasture was from originally sown species compared with about 60% in the cocksfoot based pastures. Lucerne (not shown) was about 85% pure due to winter weed control.
- In Years 1-3 the RG/Wc pastures maintained a high proportion of ryegrass and white clover. Most experiments only run for 3 years – this long-term experiment shows how this pasture deteriorated from Year 4 to Year 9.
- By Year 5-6 only about half the yield in RG/Wc pastures is from the sown species. Ideally pasture renewal would be recommended at this point.
- By Year 9 only about 10% of the 6.6 t DM/ha that was produced was from RG or Wc.
- For cocksfoot, sown pasture species decreased by about 3% per year. This meant after 9 years about 60% of the total yield produced by the four cocksfoot based pastures was from the originally sown pasture species.
- Cocksfoot was persistent but pasture vigour had declined. These pastures did not require renovation but had the potential for increased production. We recommend overdrilling in autumn with 10 kg/ha sub clover plus 1 kg/ha white clover to increase clover content and nitrogen fertility which would stimulate production from the existing cocksfoot component.



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

RG/Wc pastures

Spring WUE



Moot *et al*. 2008

Lucerne Objectives

- Describe management to maximise production, quality and persistence
- Describe key establishment issues
- Examples of lucerne on farm.

Growth:

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

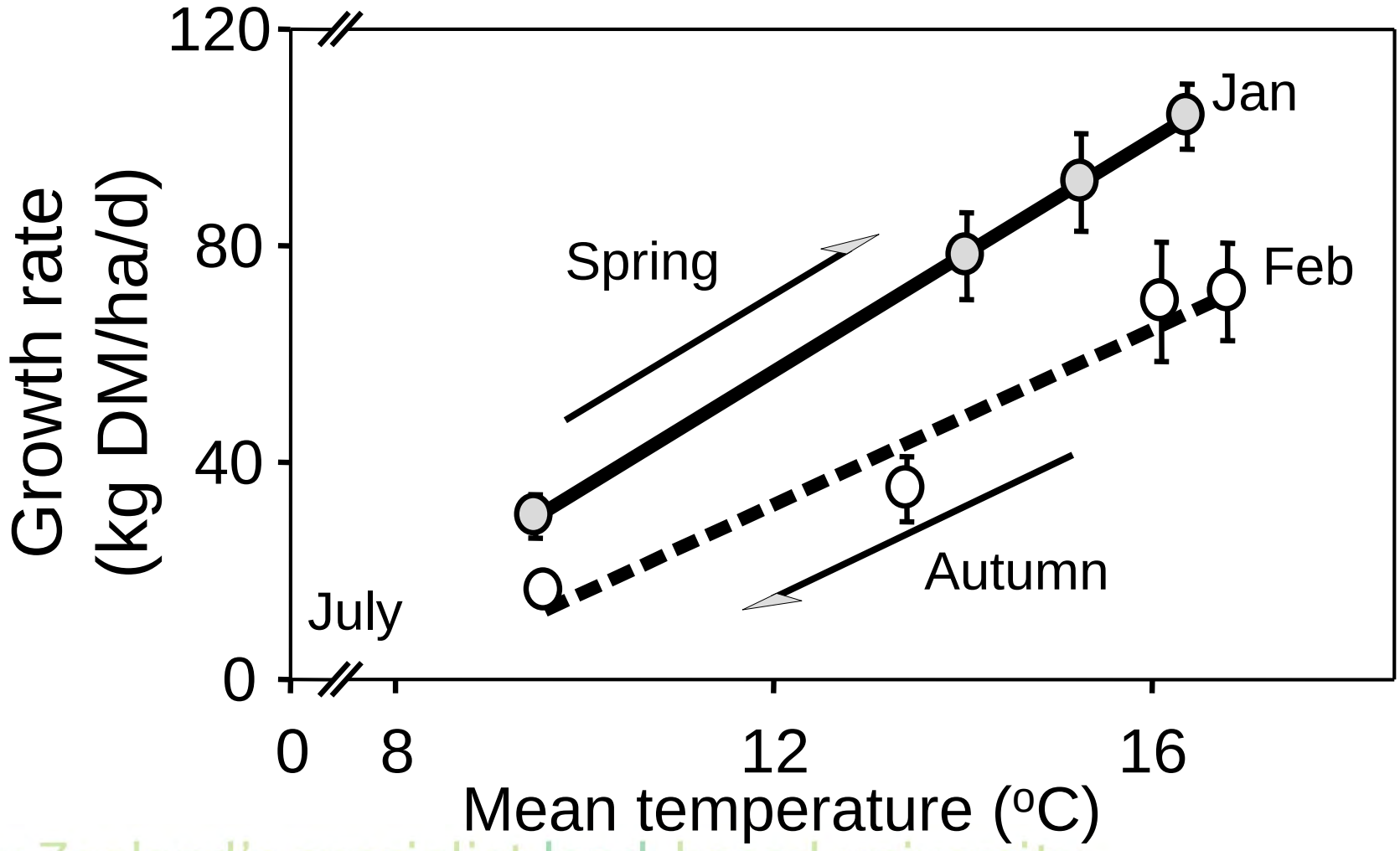
Development:

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

Vegetative growth



Moot *et al*. 2003

Experiment 2
flexible grazing

38 days resting

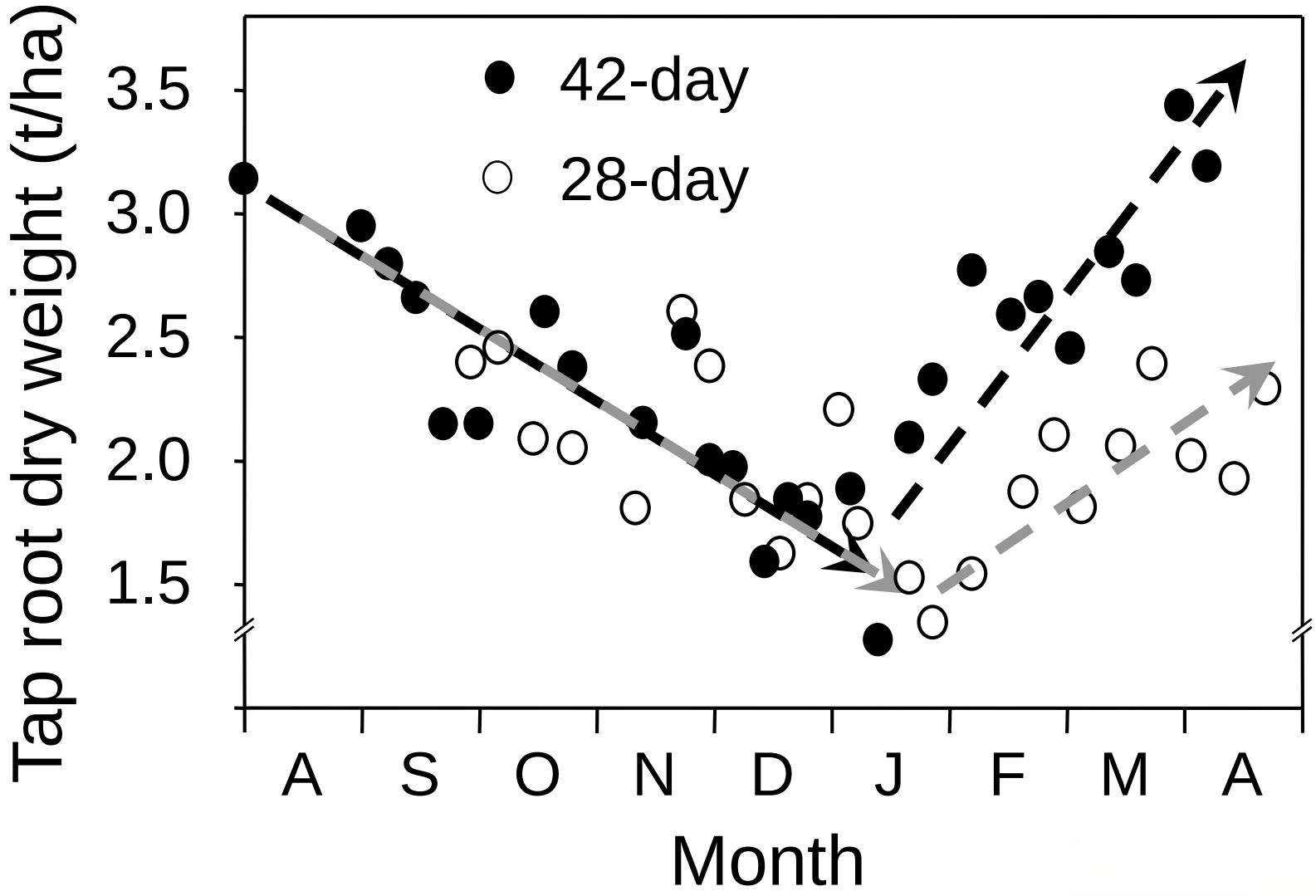
4 days grazing

25 days resting

3 days grazing

What's going on down there?

Partitioning to roots



Moot *et al*. 2003

Seasonal grazing management

Spring

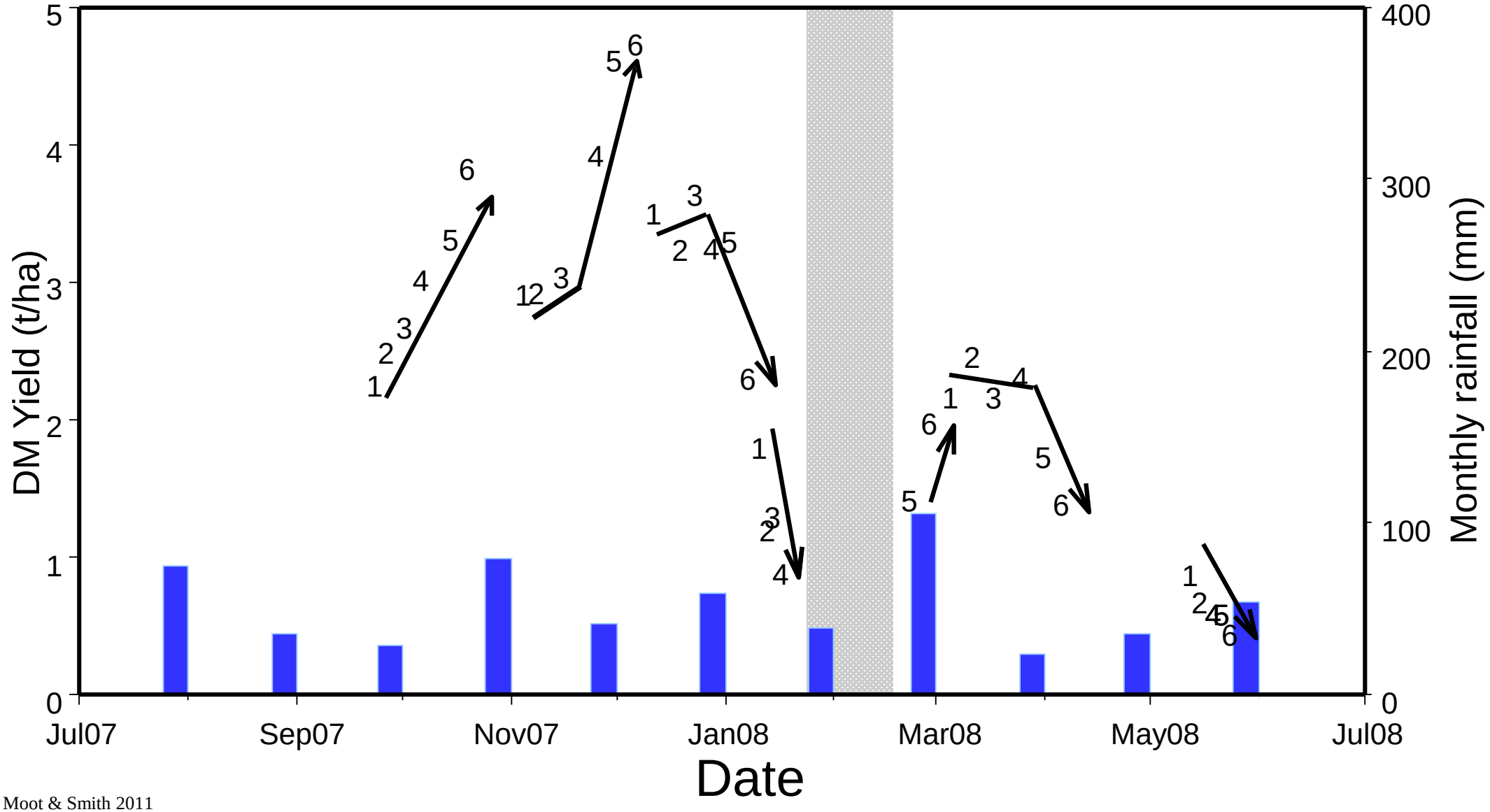
- 1st rotation aided by root reserves to produce high quality vegetative forage.

- 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

MaxClover – 38-42 day rotation



Moot & Smith 2011
Practical Lucerne Management Guide

Rotation 2 Pre-graze
Plot 1 (2/11/07, 38 d)
2.9 t DM/ha
35-40 cm tall

5th September 2011 – Cave Sth Canterbury

Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

Stocking rates in New Zealand

- Spring 14 ewes plus twins/ha
- Summer 70 lambs/ha
- Ideally 7-14 days maximum on any one paddock
- Less intensive systems – don’t open the canopy

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


14 ewes + twins/ha

High numbers for 7-10 days


Fibre and salt

Maximize reliable spring growth – high priority stock

Seasonal grazing management

Early autumn (*Feb-April*)

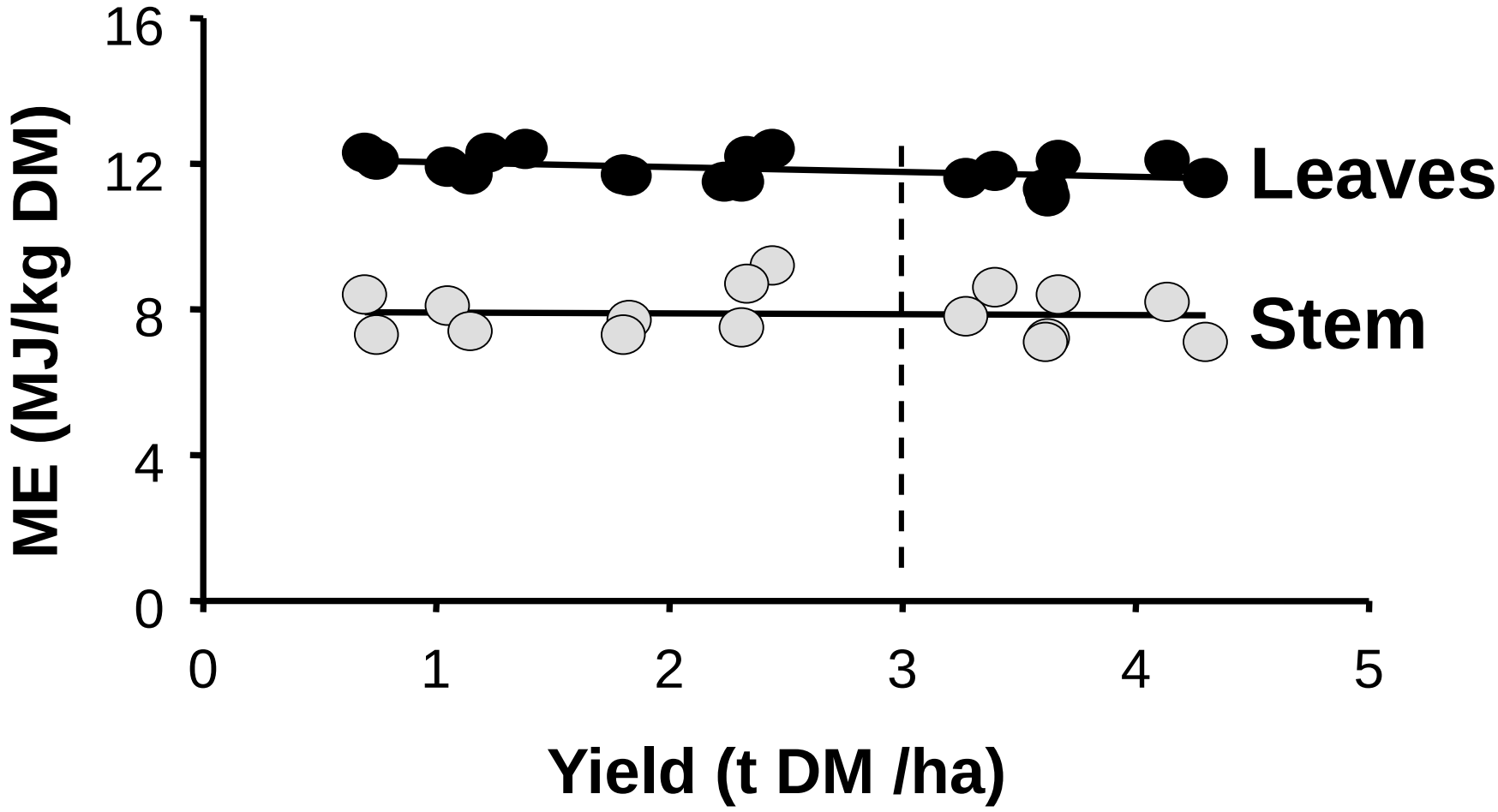
- terminal drought ⇒ graze standing herbage
- allow 50% flowering
- long rotation (42 days) somewhere between Jan and end of May.

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

Autumn = flowering plants
But don't flush on this!

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

Metabolisable energy of lucerne



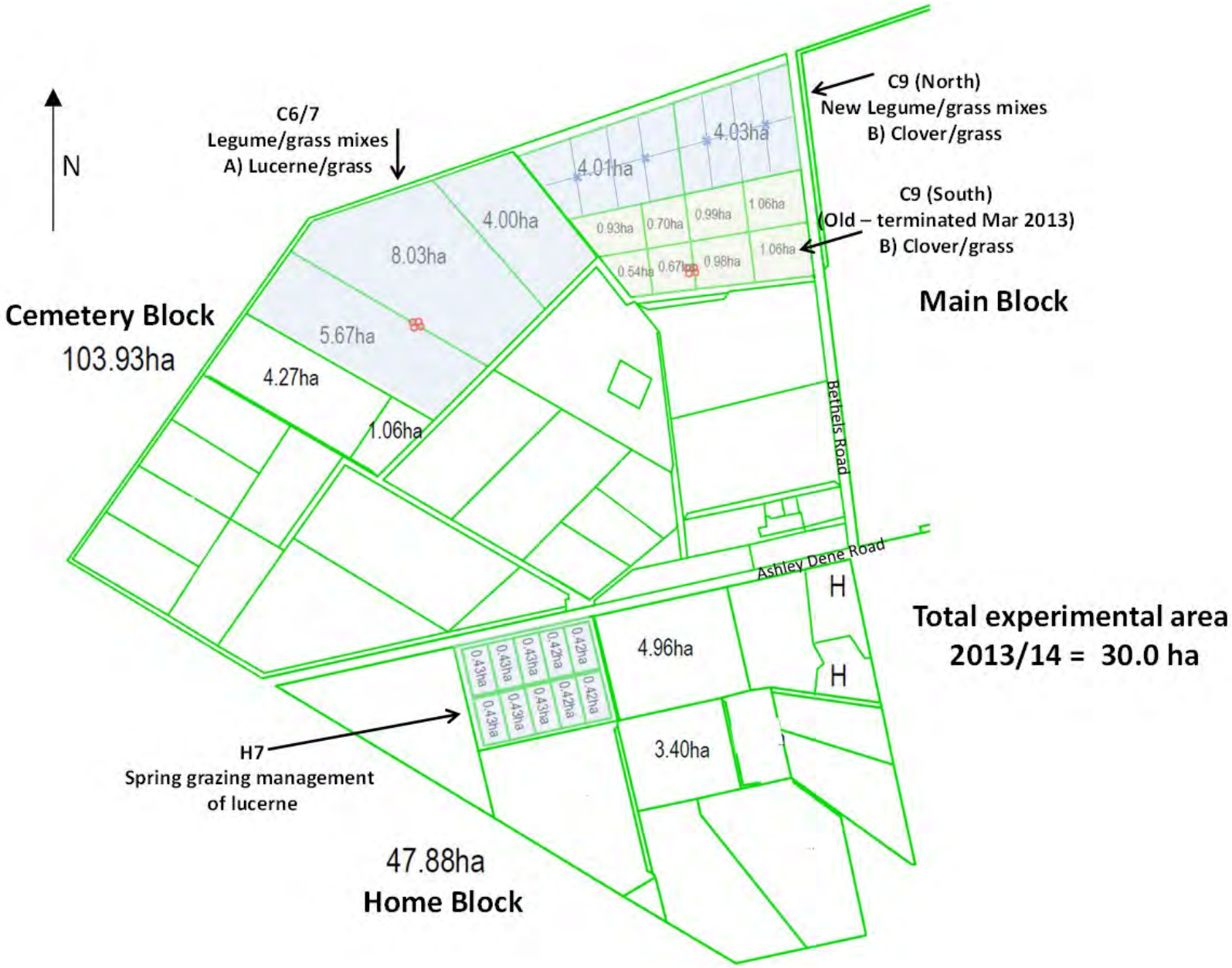
Brown & Moot 2004

Animal health

- **Clostridial bacteria:** vaccinate
- **Cobalt:** vitamin B12 injection
- **Worm haven:** Camping on small area – river edge?
- **Avoid flushing if:** leaf spots or flowering lucerne
  - new regrowth or tops only are O.K.

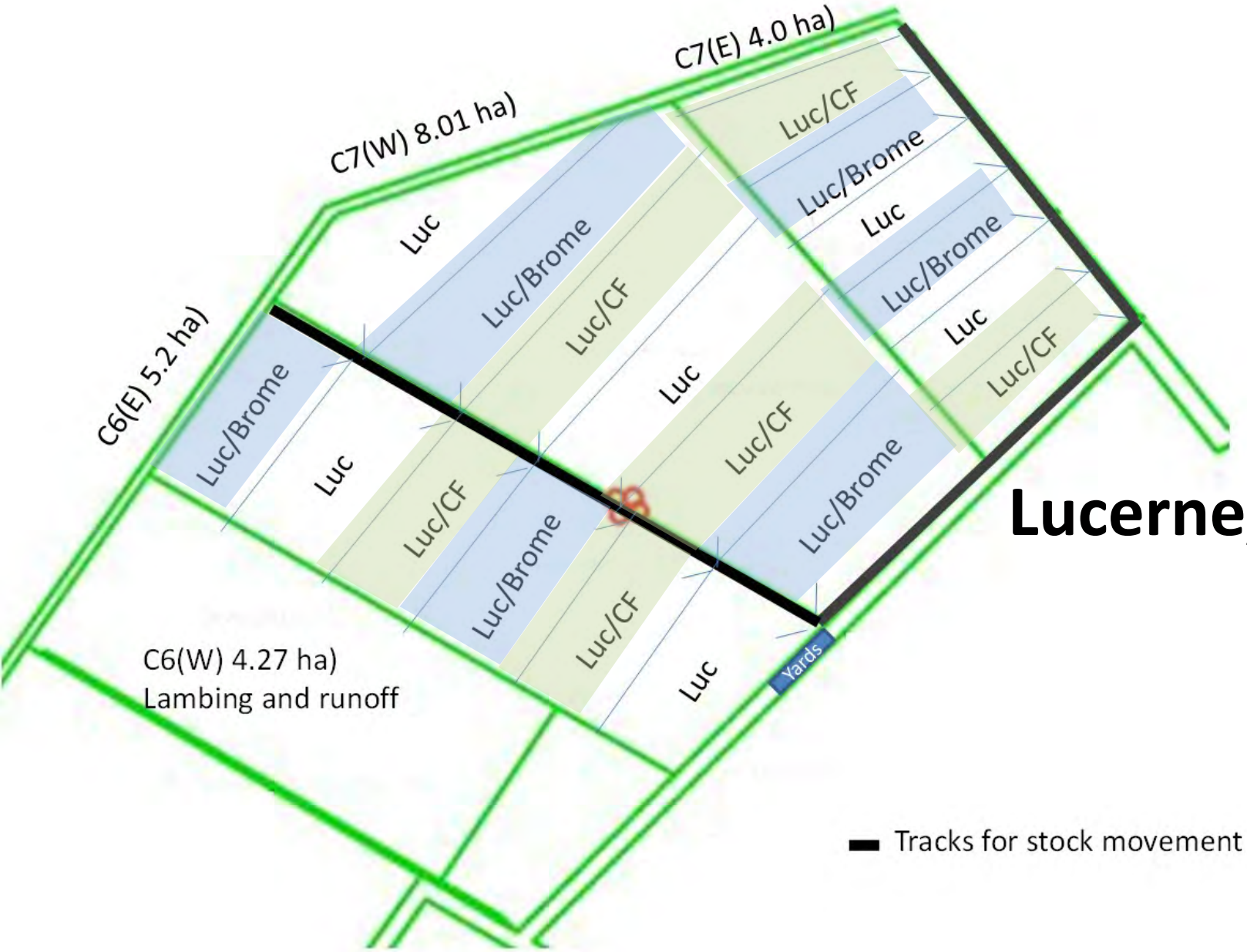
Animal health

- **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



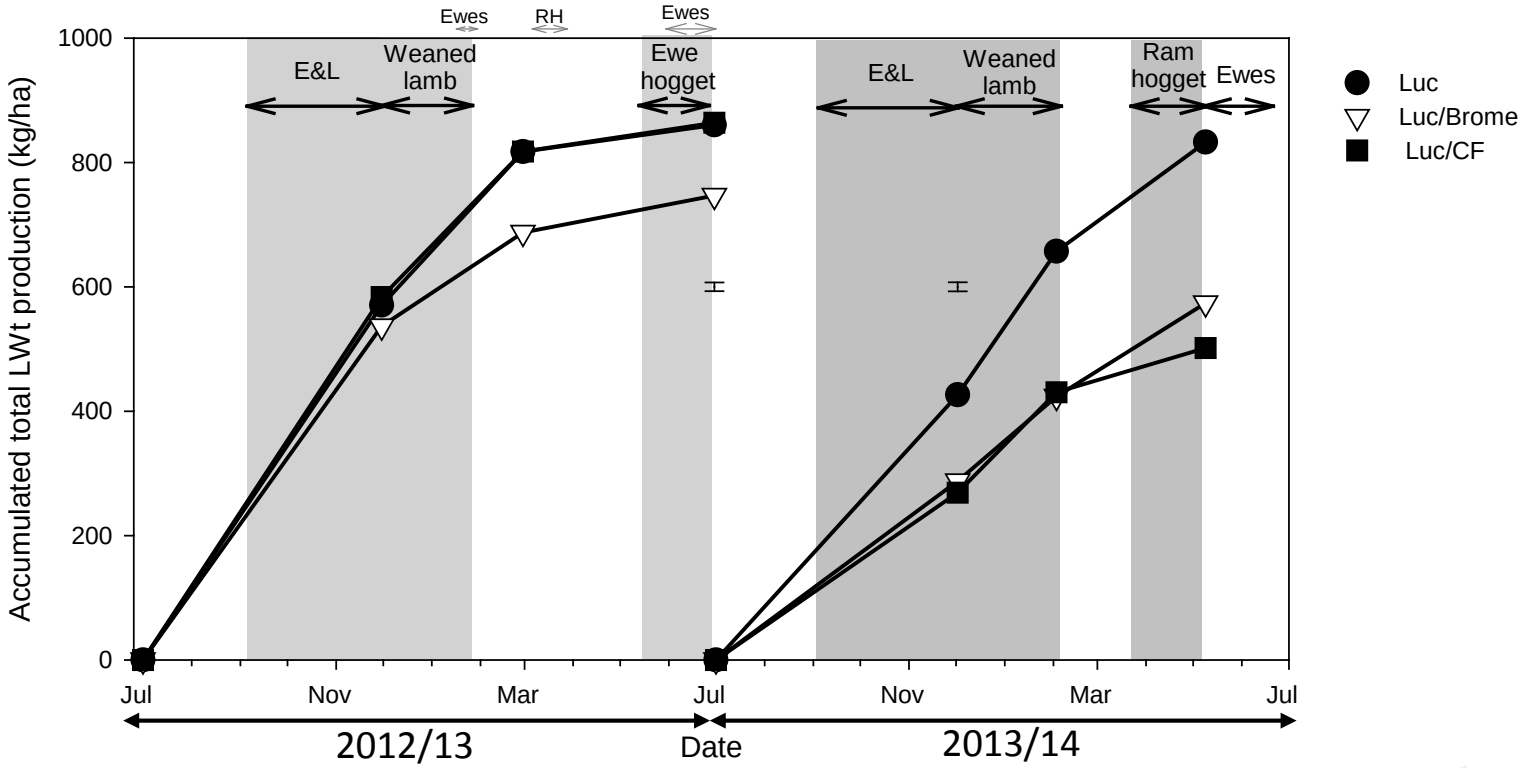
Total experimental area
2013/14 = 30.0 ha

Lucerne/grass mixes

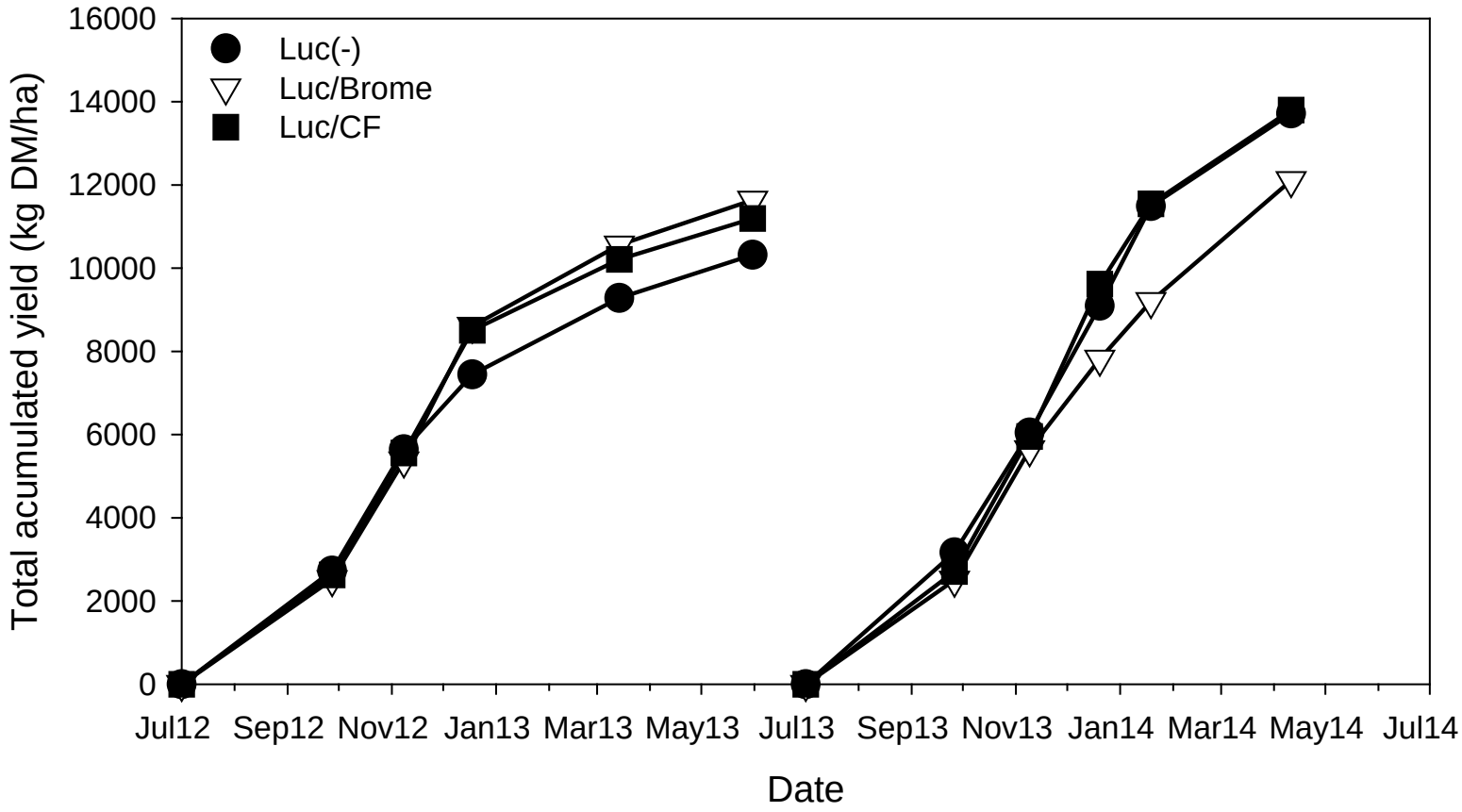


Early spring

Total Accumulated LWt production



DM Yield


16000
14000
12000
10000
8000
6000
4000
2000
0
Total acumulated yield (kg DM/ha)
Luc(-)
Luc/Brome
Luc/CF
Jul12
Sep12
Nov12
Jan13
Mar13
May13
Jul13
Sep13
Nov13
Jan14
Mar14
May14
Jul14
Date

Plot 2
Luc/CF
24 Oct 2012


Plot 10
Luc/CF
17 Oct 2012

Lucerne/cocksfoot mix – Sept 2013

Plot 3
Luc/brome
24 Oct 2012


Plot 11
Luc/brome
17 Oct 2012

Plot 7
Luc/brome
11 Oct 2013

Plot 17
Luc/brome
14 Nov 2013


3 Feb 2014


3 Feb 2014
Luc/CF

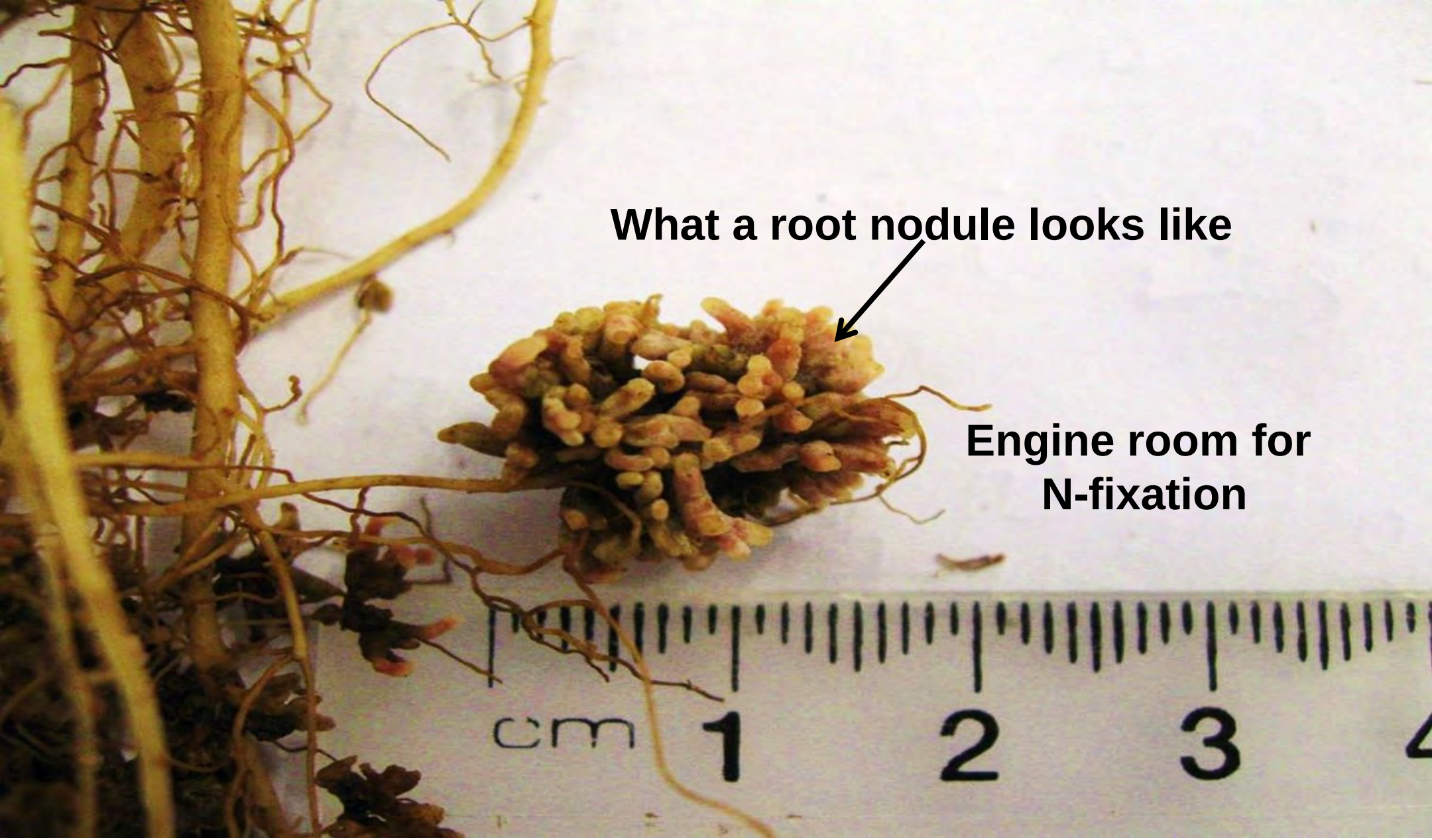

3 Feb 2014
Luc/brome


3 Feb 2014
Luc

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)


What a root nodule looks like
Engine room for
N-fixation
cm
1
2
3

Lucerne root

~8 months after sowing

> 1.5 m length

Autumn Spraying

Timing is Critical

Most important tool

Glyphosate, granstar, penetrant

Key Results

Conserve soil moisture

Kill mass root systems

Kearney *et al.* 2010

Drilling seed with fertiliser
Direct drilling = seed + fertiliser

Hills Creek Station

Sown 4/11/2008

Photo taken 5/11/2010


Over 60,000 ha sown and doubling of lucerne seed sales over 10 years
“35% Rate of return on investment”

Sowing rate and date

Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

Established 2007 LU – Templeton silt loam

Coated 'Grasslands Kaituna' lucerne.

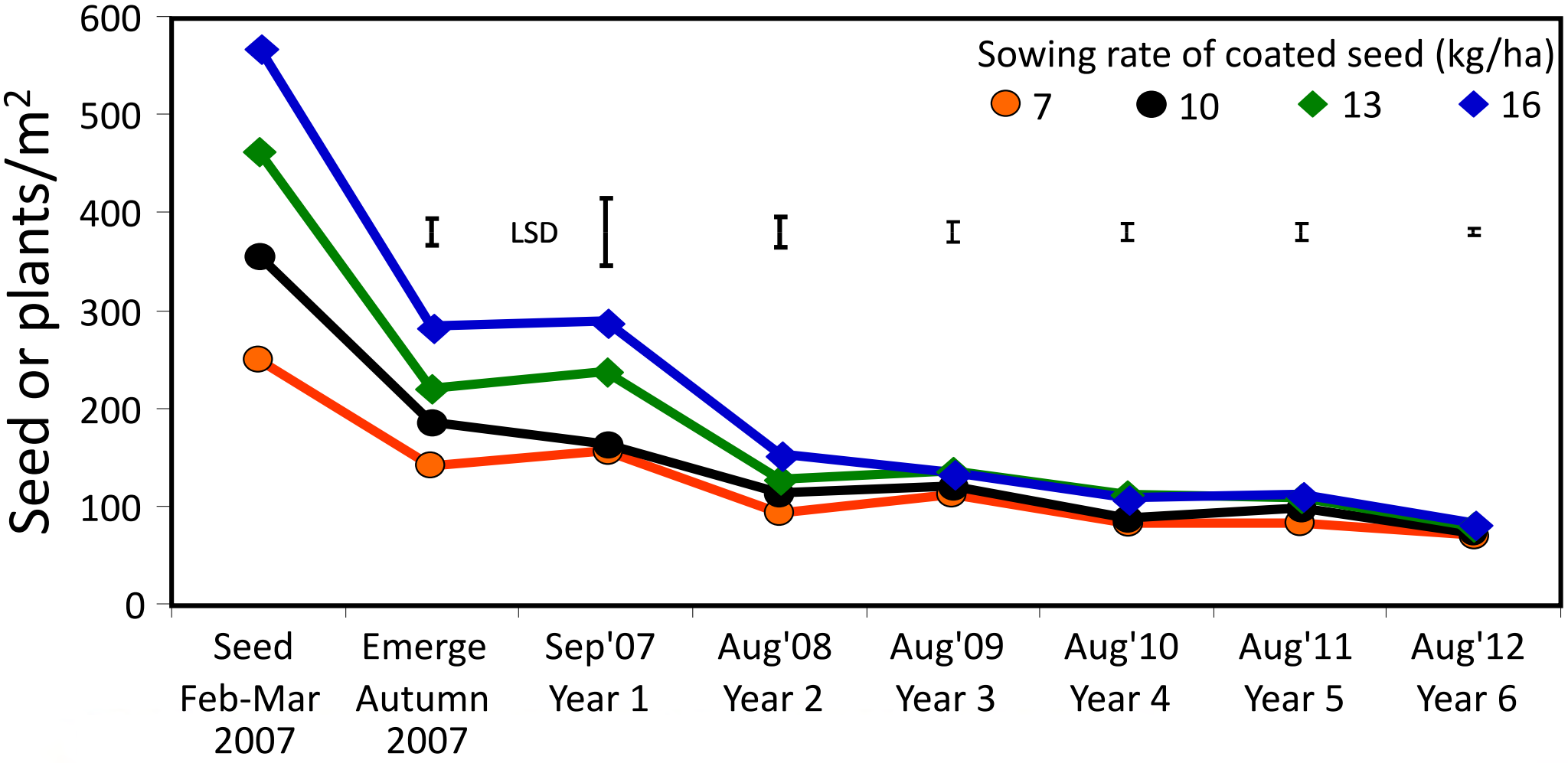
Four sowing dates

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

Four sowing rates

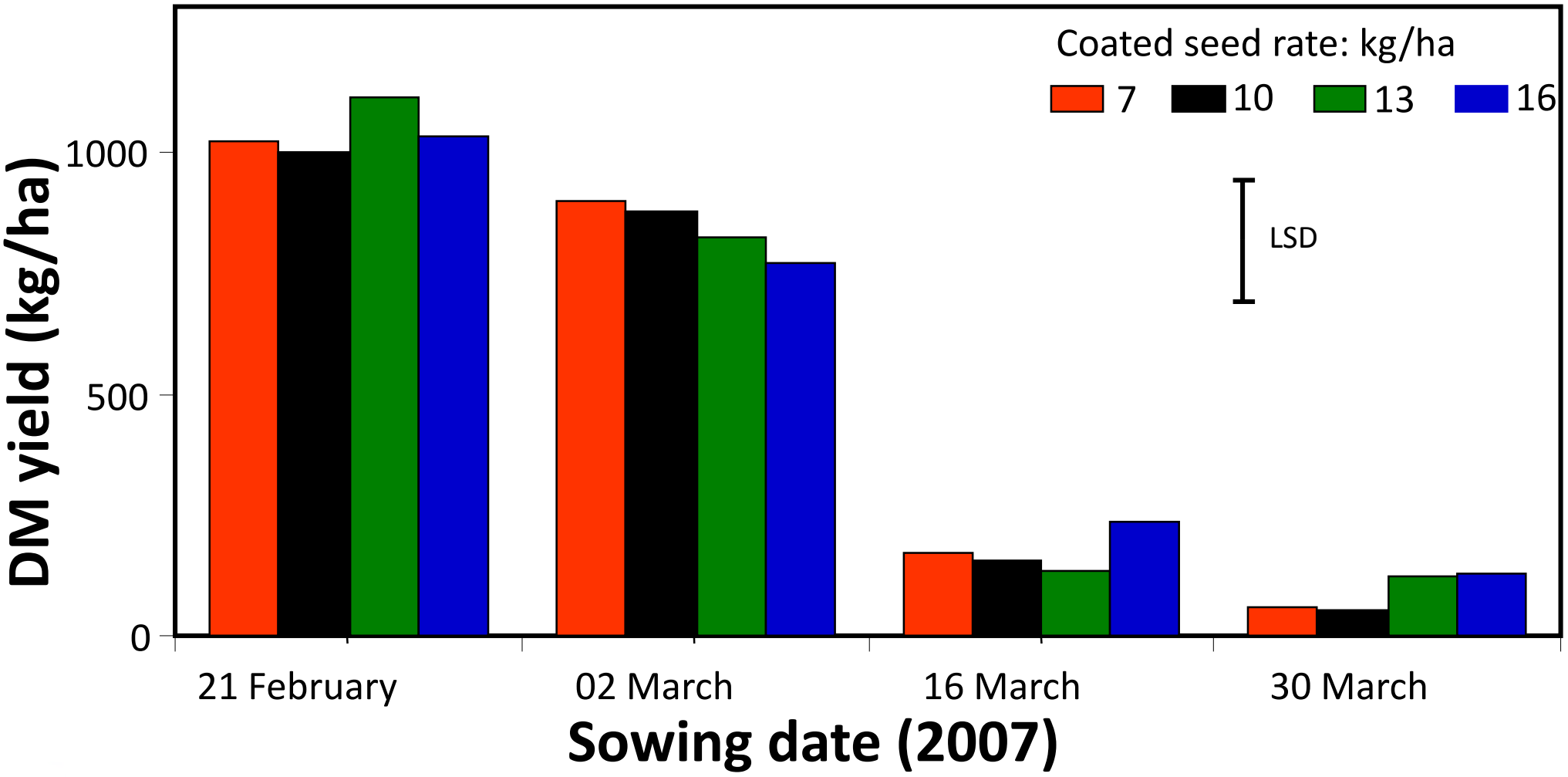
- **Equivalent to bare seed @ 7, 10, 13 and 16 kg/ha**

Sown seed & plant population over time



Moot *et al*. 2012

Seedling lucerne yield to early June

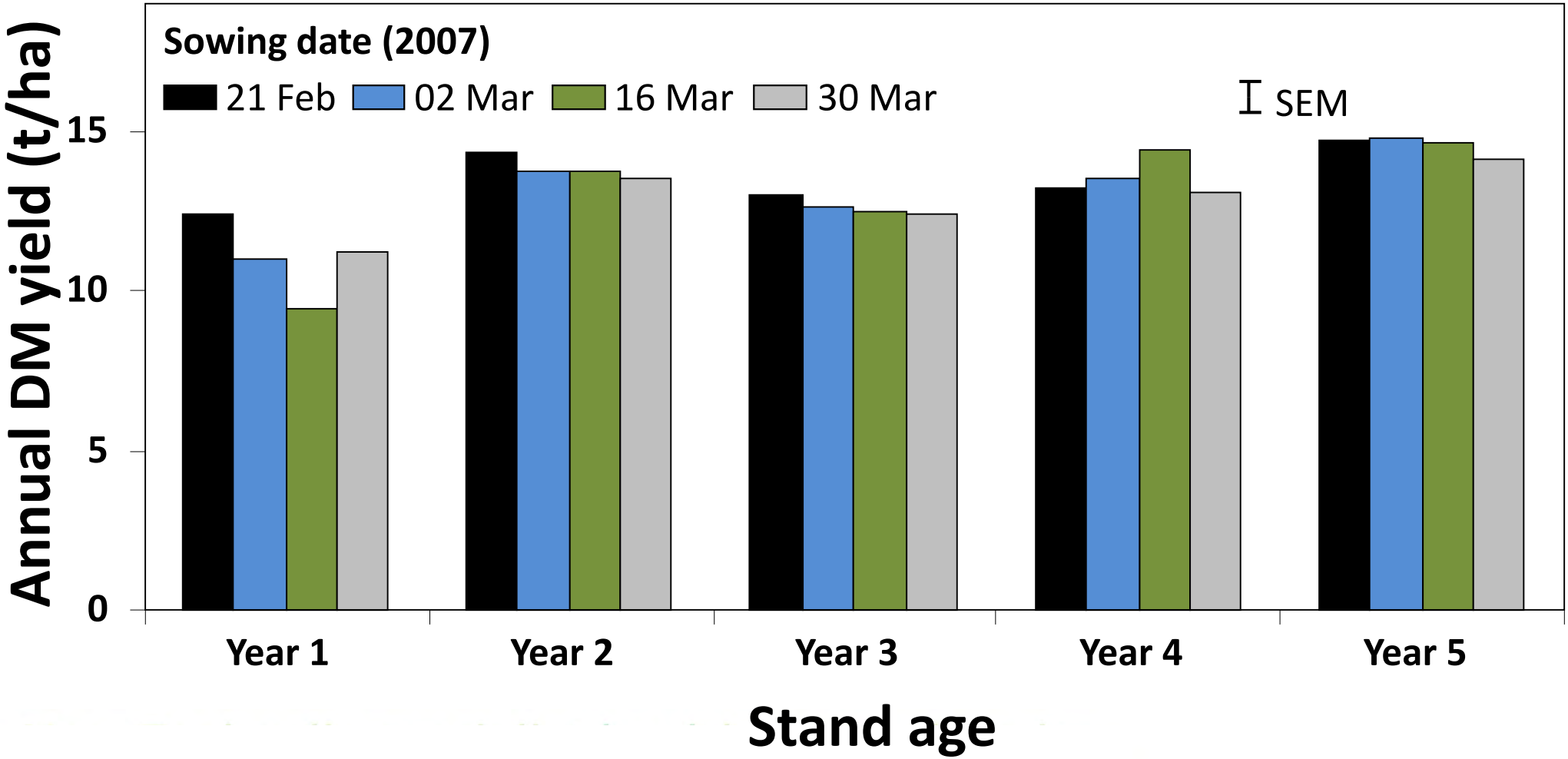


Moot *et al*. 2012

Weeds present @ 09 October 2007 (Year 1)

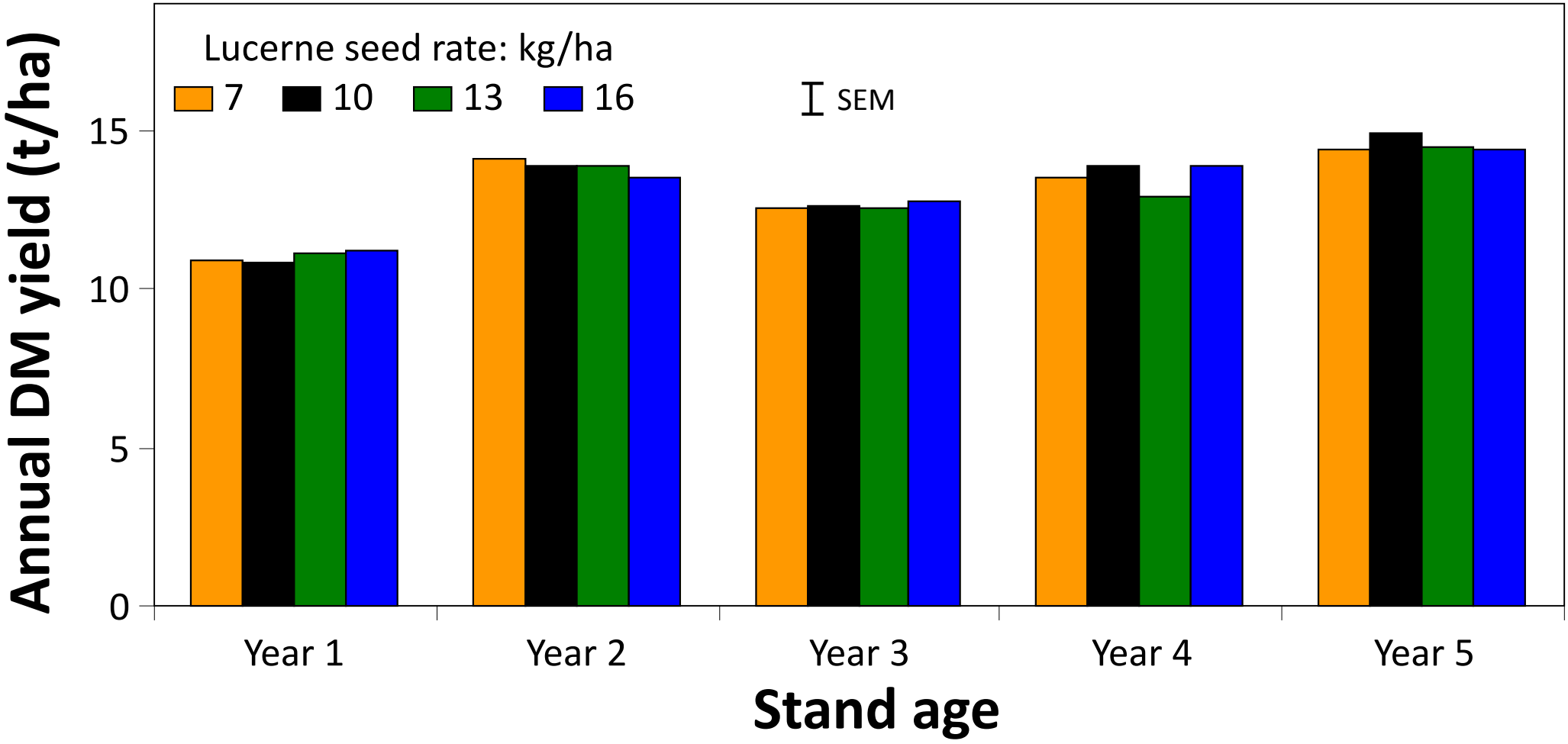
Sown 21 Feb 2007 **Sown 30 Mar 2007**

Annual yield in relation to sowing date

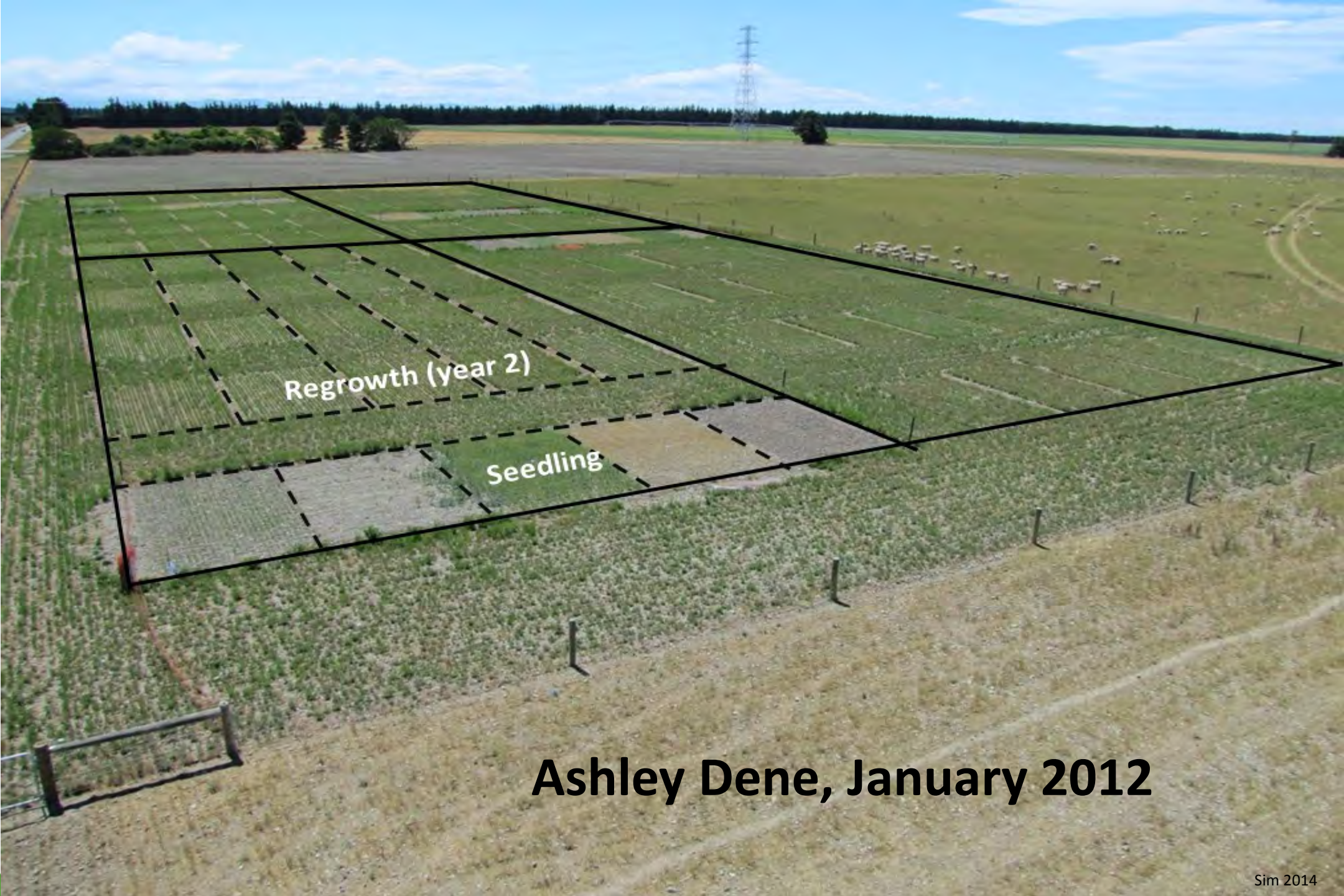


Moot *et al*. 2012

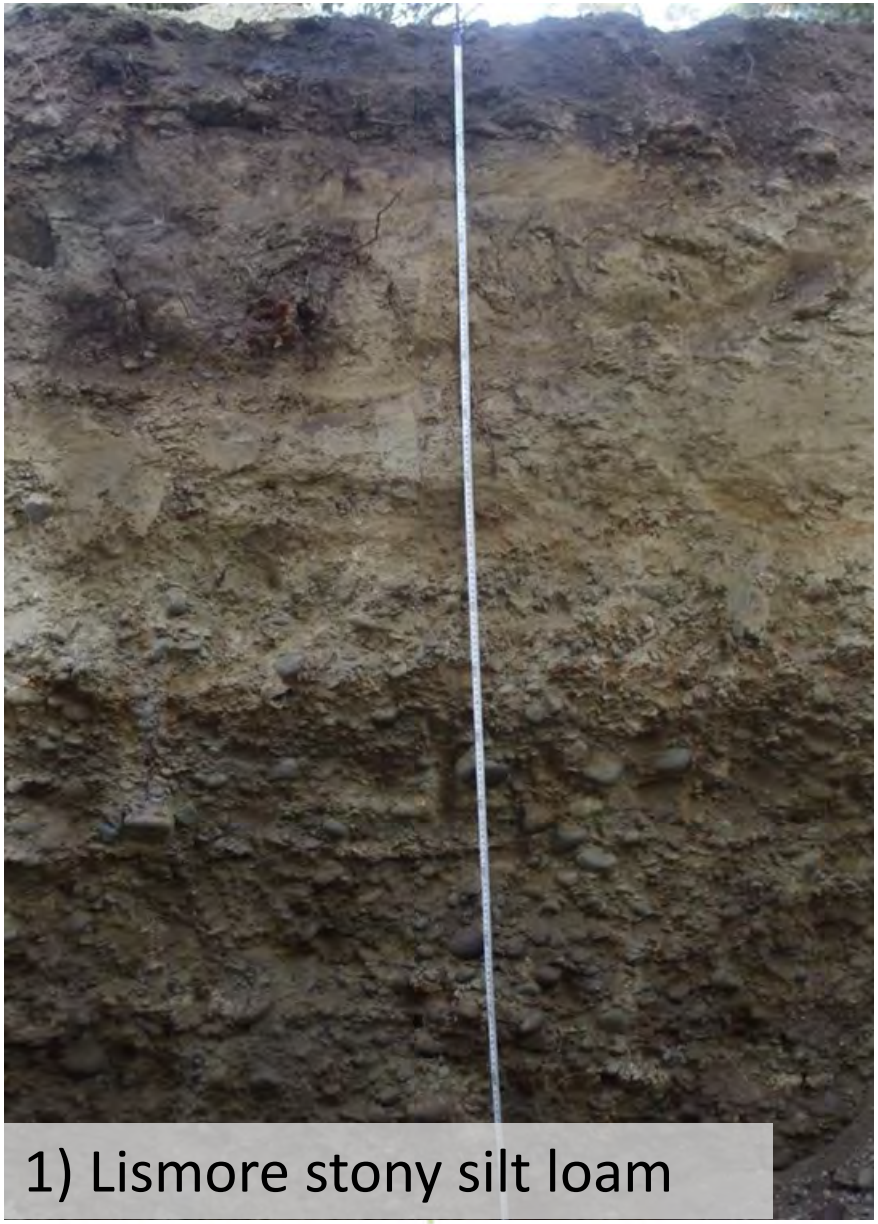
Annual yield in relation to sowing rate

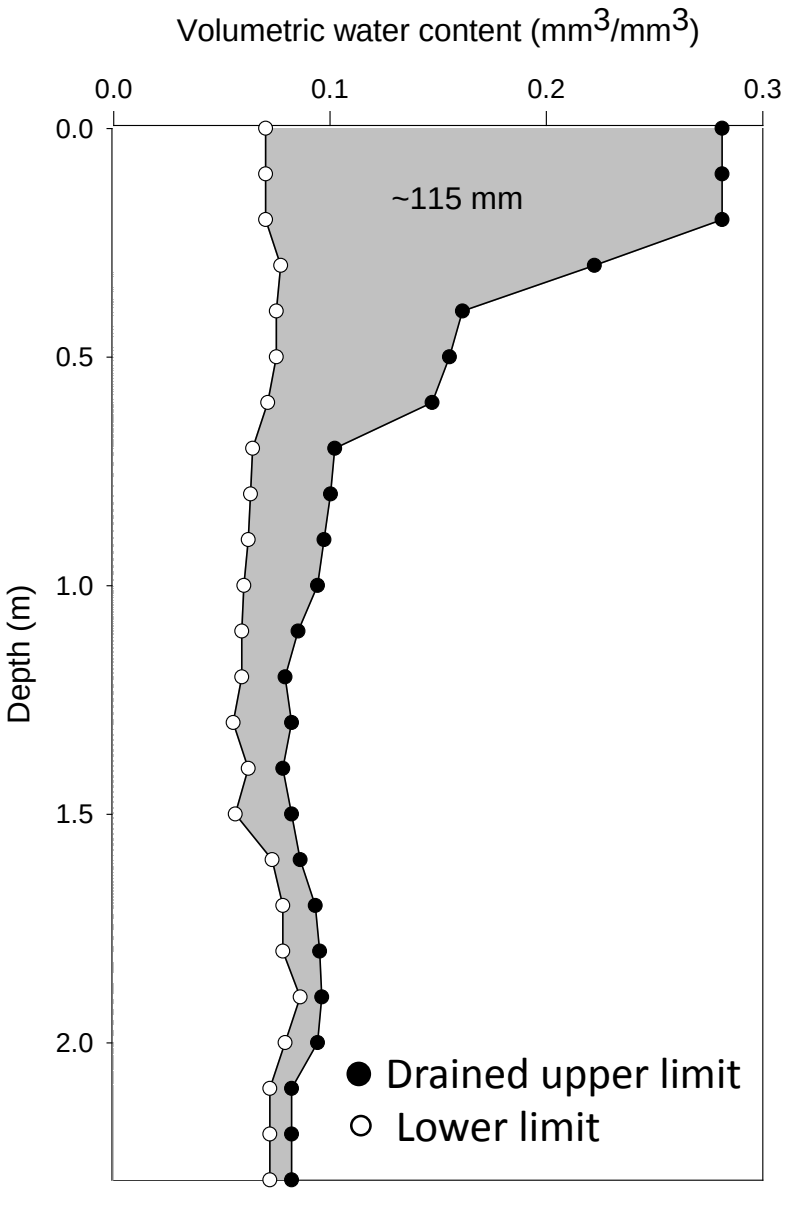


Moot *et al*. 2012

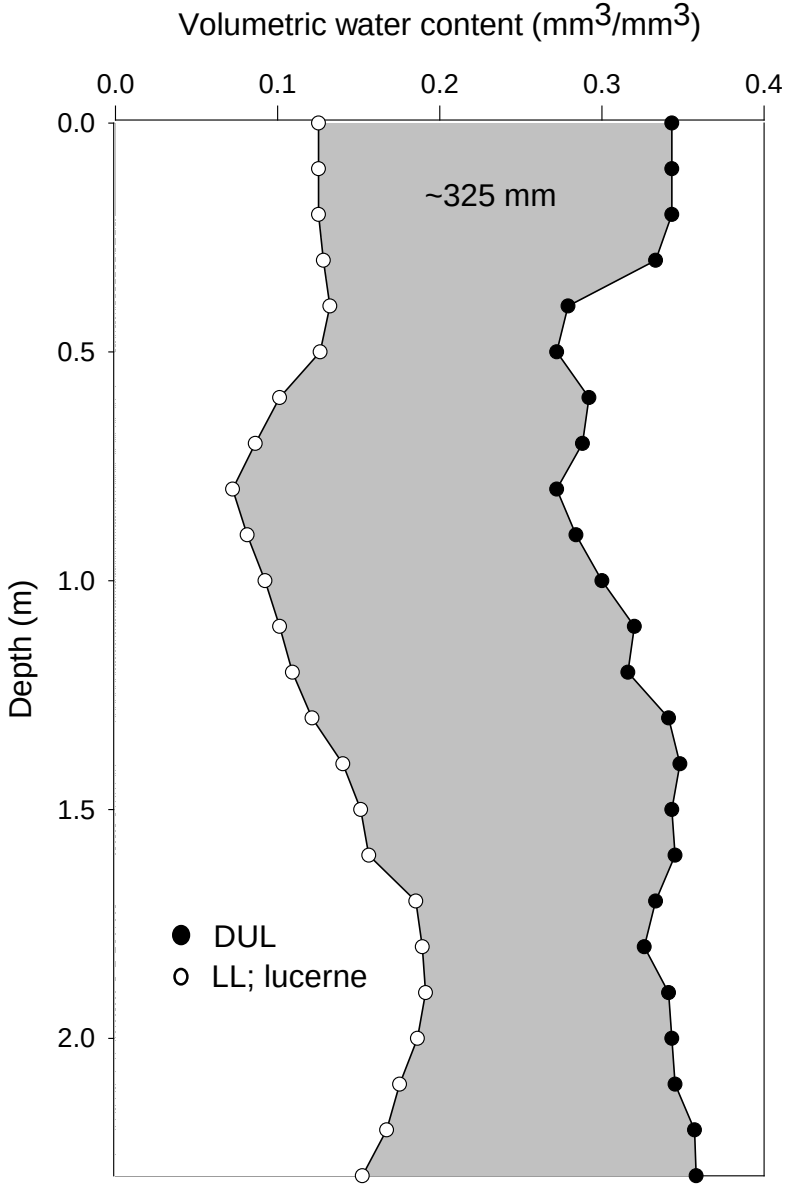


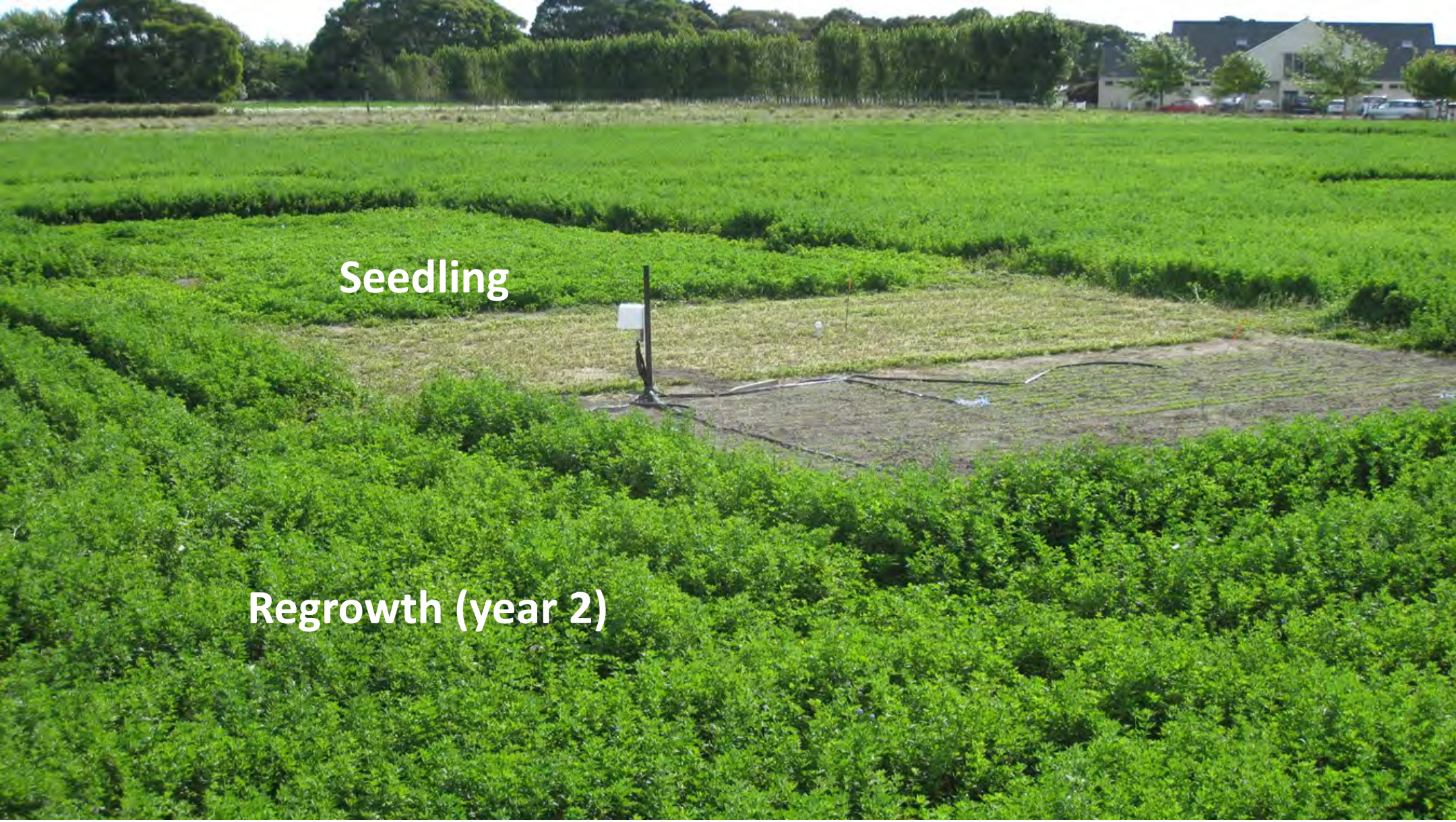
Sim 2014


1) Lismore stony silt loam

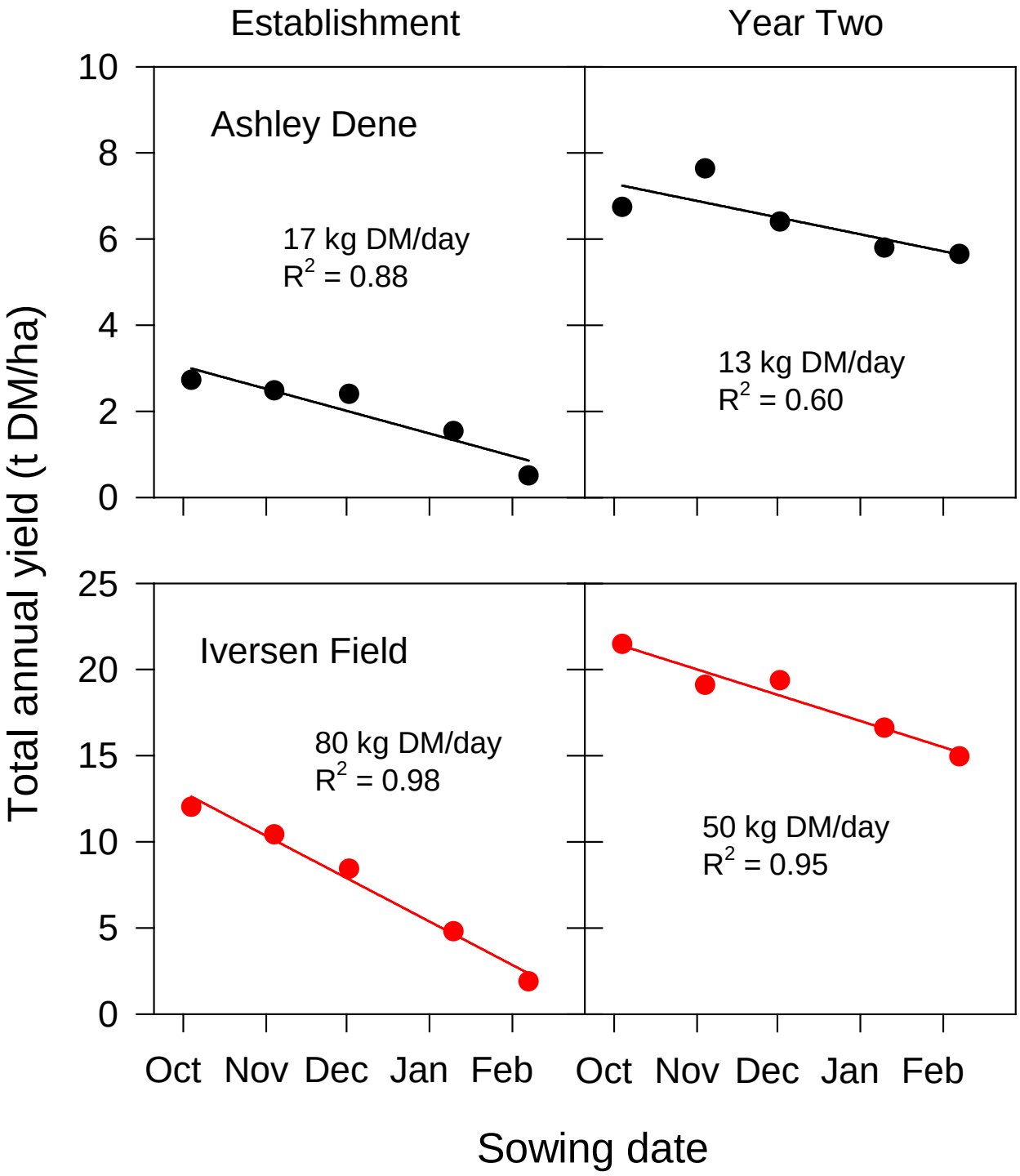

Volumetric water content (mm3/mm3)
0.0
0.1
0.2
0.3
0.0
0.5
1.0
1.5
2.0
Depth (m)
~115 mm
Drained upper limit
Lower limit

2) Wakanui silt loam





Iversen 12, January 2012



Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

Delayed sowing cost yield

Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

Taproot mass

Conclusions from establishment

- Spring sow - October
- Yield in year one is lower due to partitioning
- Plant population self thins over time
- Sow on deep soils

Irrigation

- Before sowing to encourage root growth
- When the canopy is closed to reduce soil evaporation and weed growth
- Large amounts (50 mm) infrequently rather than small (15 mm) amounts frequently
- Fallow – dry soil vs wet soil

Fertilizer

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

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

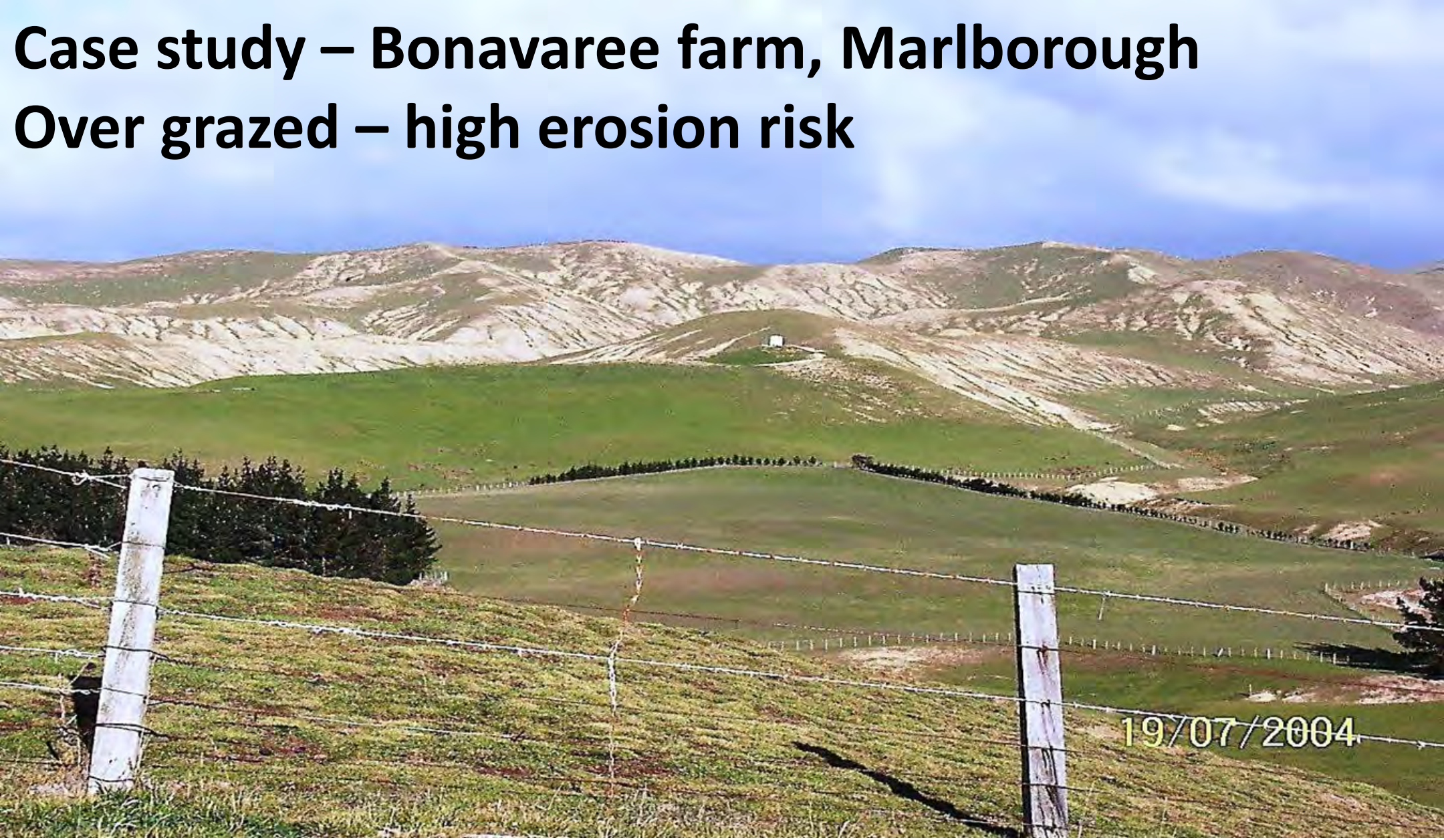
Or

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

Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

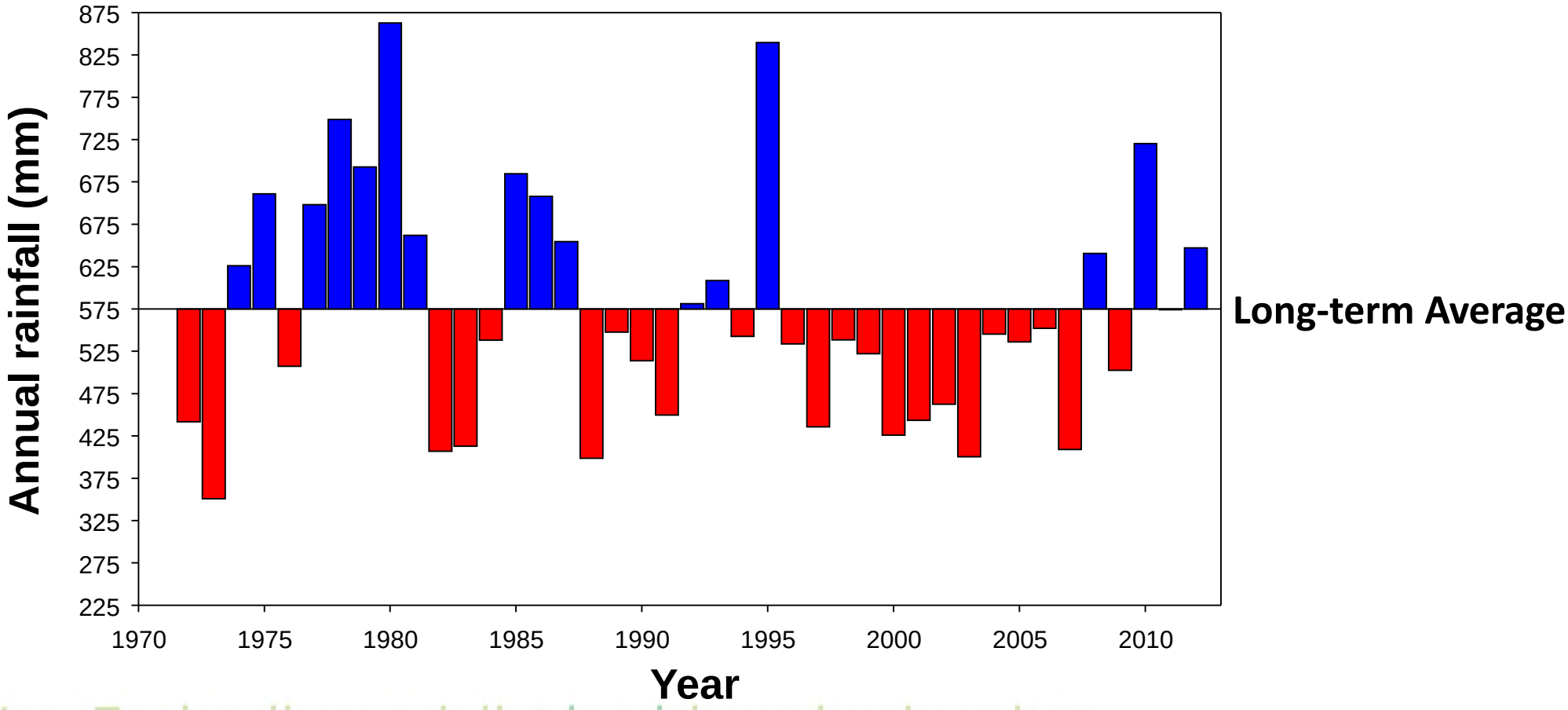
Case study – Bonavaree farm, Marlborough

Over grazed – high erosion risk

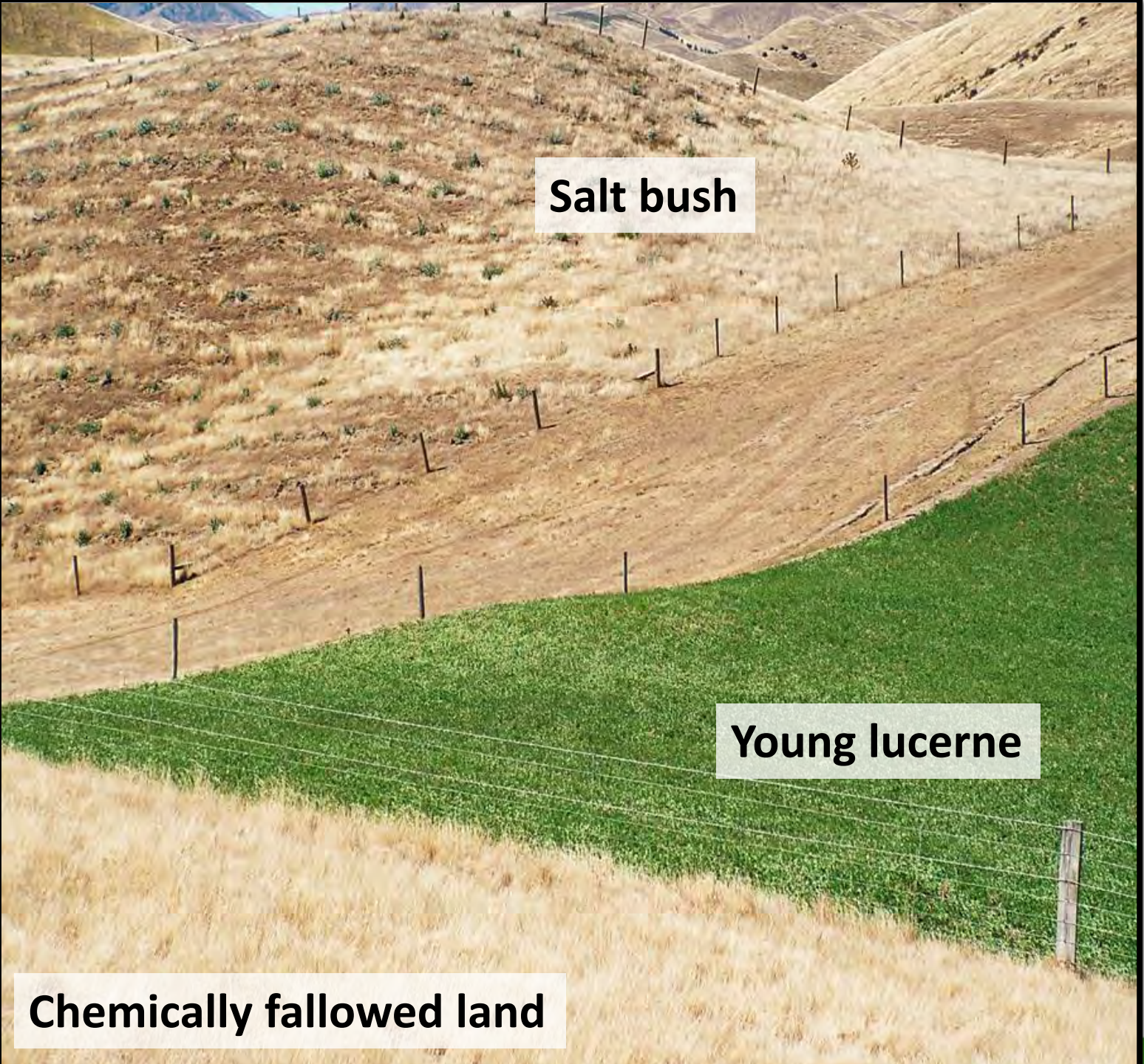


Avery *et al*. 2008

Annual rainfall at ‘Bonavaree’



Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND



Lincoln University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND

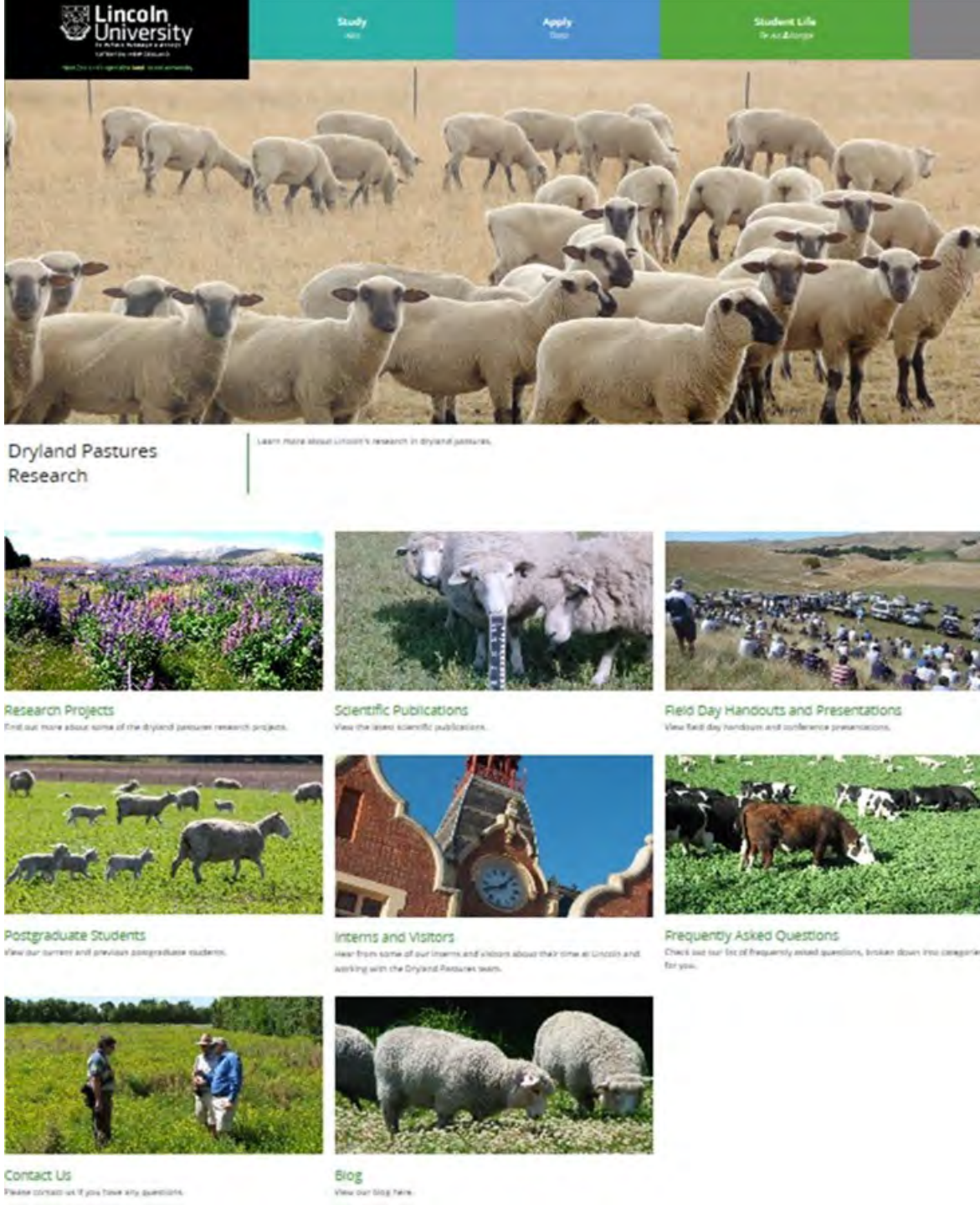
‘Bonavaree’ production change over 10 years

	2002	2012	Change
Land area (ha)	1100	1800	↑ 64%
Sheep numbers	3724	4158	↑ 12%
Lambing (%)	117	145	↑ 24%
Lamb weights (kg)	13.3	19	↑ 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%

The website…

Info on:

- Current projects
- Field day presentations
- Scientific publications
- FAQs
- Postgraduate study



www.lincoln.ac.nz/dryland

Conclusions

- Lucerne growth rate is seasonal based on storage and remobilization of reserves
- Lucerne can be grazed or cut and carried based on yield – not time of flowering
- Replace nutrients removed through cut and carry (K)
- Minimize soil evaporation by timing of irrigation

Dryland Pastures — Conversations at Lincoln University

Home | About | People

Set stocking lucerne in early spring – the stuff you need to know

Posted on 31/10/2014 by Anna Mills

Posted on behalf of Prof. Derrick Moot

This grazing management is based on new research out of Lincoln University. It is recommended **ONLY** for farmers with a large proportion (**>40%**) of their properties in lucerne who require greater areas to lamb on in early spring and who already follow the optimum rotational grazing management system advocated by Prof. Moot and Lincoln University's Dryland Pastures Research Team.

After 15 years telling people never to set stock on lucerne Prof. Moot has mellowed (…slightly). The rules for set stocking lucerne outlined below must be followed. Failure of farmers/managers to follow these guidelines may result in killing your lucerne stand within 2 years. Deviations from the guidelines are at your own risk.

Planning for spring set stocking happens in early autumn

Search

Recent Posts

- Set stocking lucerne in early spring – the stuff you need to know
- Upcoming Dryland Pastures Seminar – Marlborough 28 August
- Testing legume nodules to identify what rhizobia is fixing legume nitrogen
- Lupins at Sawdon – March 2014

Dryland Pastures Blog:

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

References & Links

Dryland pastures website: http://www.lincoln.ac.nz/dryland

Dryland Pastures blog: http://www.lincoln.ac.nz/conversation/drylandpastures/

MaxClover photo diary (PDF 18.7 MB)

Avery, D., Avery, F., Ogle, G. I., Wills, B. J. and Moot, D. J. 2008. Adapting farm systems to a drier future. *Proceedings of the New Zealand Grassland Association*, **70**, 13-18.

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.

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.

Mills, A., Lucas, R. J. and Moot, D. J. 2014a. 'MaxClover' Grazing Experiment: I. Annual yields, botanical composition and growth rates of six dryland pastures over nine years. *Grass and Forage Science*, ***In Press (DOI 10.1111/gfs.12132)***.

Mills, A., Lucas, R. J. and Moot, D. J. 2014b. 'MaxClover' Grazing Experiment. II. Sheep liveweight production from six grazed dryland pastures over eight years. *New Zealand Journal of Agricultural Research*, **XX**, XXX-XXX (In Press).

Moot, D. J. 2012. An overview of dryland legume research in New Zealand. *Crop and Pasture Science*, **63**, 726–733.

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., 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. 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.

Sim, R. E. 2014. Water extraction and use of seedling and established dryland lucerne crops. PhD thesis, Lincoln University, Lincoln, Canterbury. 264 pp.