

Te Anau  
17<sup>th</sup> September 2014



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# Lucerne Agronomy

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New Zealand's specialist land-based university



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# The website...

## Info on:

- Current projects
- Field day presentations
- Scientific publications
- FAQs
- Postgraduate study
- Photo Diary
- Direct link to BLOG

The screenshot shows the Lincoln University website. At the top left is the university logo with the text 'Lincoln University Te Whare Wānanga o Aoraki CHRISTCHURCH - NEW ZEALAND'. Below the logo is a navigation bar with 'Info for:' followed by a dropdown menu set to 'Current students' and a 'Go' button. To the right are links for 'Contact us' and 'Glossary', and a search box with a 'Search' button. A green horizontal bar contains several menu items: 'Studying at Lincoln University', 'Degrees, Diplomas and Certificates', 'Services, facilities and support', 'Student life at Lincoln University', 'Research at Lincoln University', 'About Lincoln University', and 'News & events'. Below this bar, a breadcrumb trail reads 'You are here: Home > Dryland pastures research'. On the right side of the page, there are links for 'Print version' and 'Email this page'. The main content area is titled 'Dryland pastures research' and includes a 'Dryland pastures research team' list with members: Derrick Moot, Dick Lucas, Alistair Black, and Annamaria Mills. Below this is a 'Research projects:' section with three items: 'Marlborough - Technology Transfer', 'MaxClover Grazing Experiment', and 'Lucerne research'. The 'MaxClover Grazing Experiment' is circled in red. To the right of the research projects is a 'Related Links' section with 'Dryland Pastures Blog' circled in red. On the left side of the page, there is a 'feedback' button and a vertical navigation menu under 'Dryland pastures research' with items: 'Research Projects', 'Scientific publications', 'Field Day handouts and presentations' (circled in red), 'Postgraduate students', 'Frequently asked questions', and 'Contact us'. A red arrow points from the 'Field Day handouts and presentations' item to the 'MaxClover Grazing Experiment' link. Another red arrow points from the 'Dryland Pastures Blog' link to the 'Direct link to BLOG' item in the list on the left.

[www.lincoln.ac.nz/dryland](http://www.lincoln.ac.nz/dryland)





# Lincoln University

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

### PHOTO DIARY - 2002/03 to 2010/11

Funded by:



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

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# 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](http://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.

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

- 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)

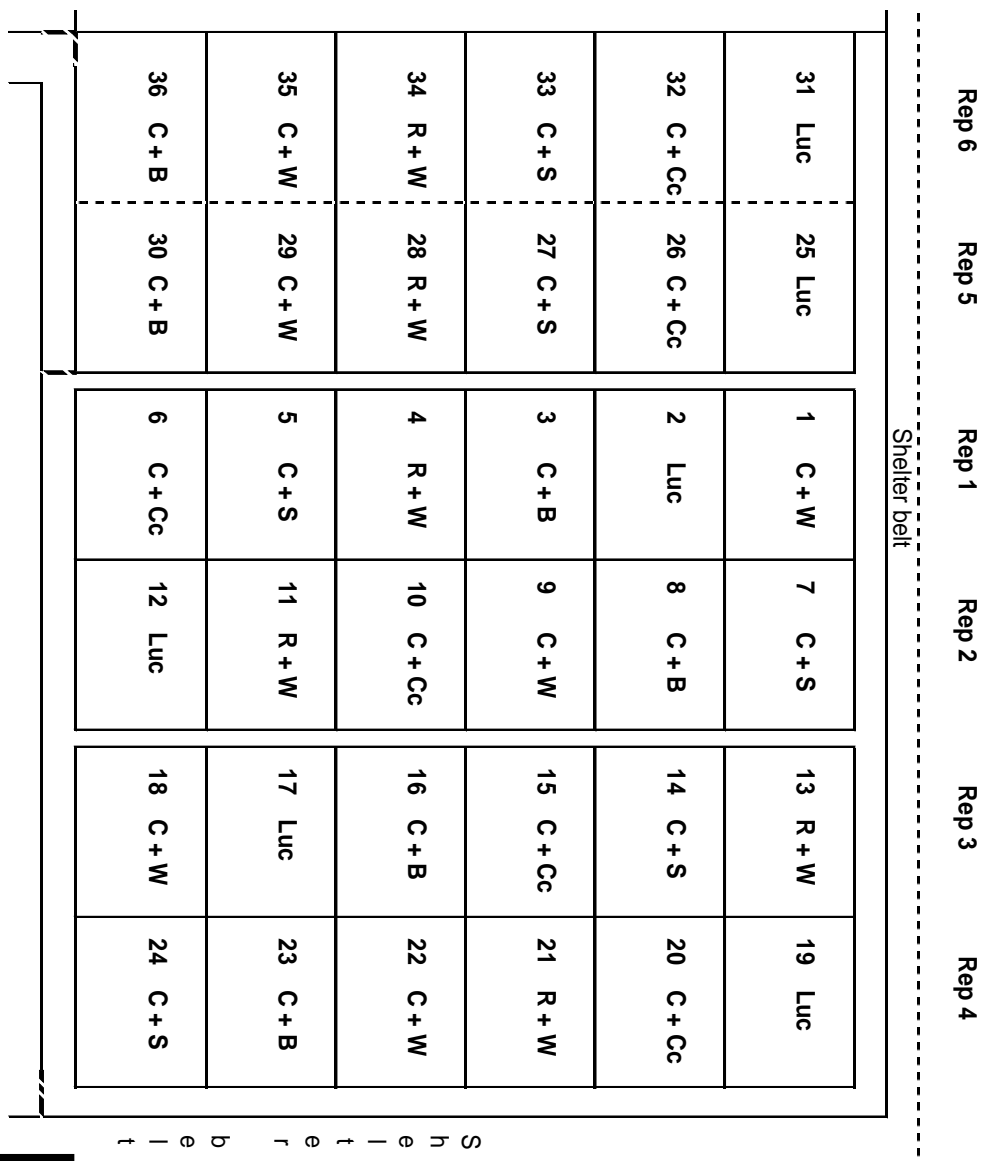
Plot sizes

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.







**RG/Wc**  
**Lucerne**  
**CF/Sub**  
**CF/Balansa**  
**CF/Cc**  
**CF/Wc**

**The 'MaxClover' Grazing experiment in paddock H19 at Lincoln University**



# Grazing management



Lucerne was always rotationally grazed.

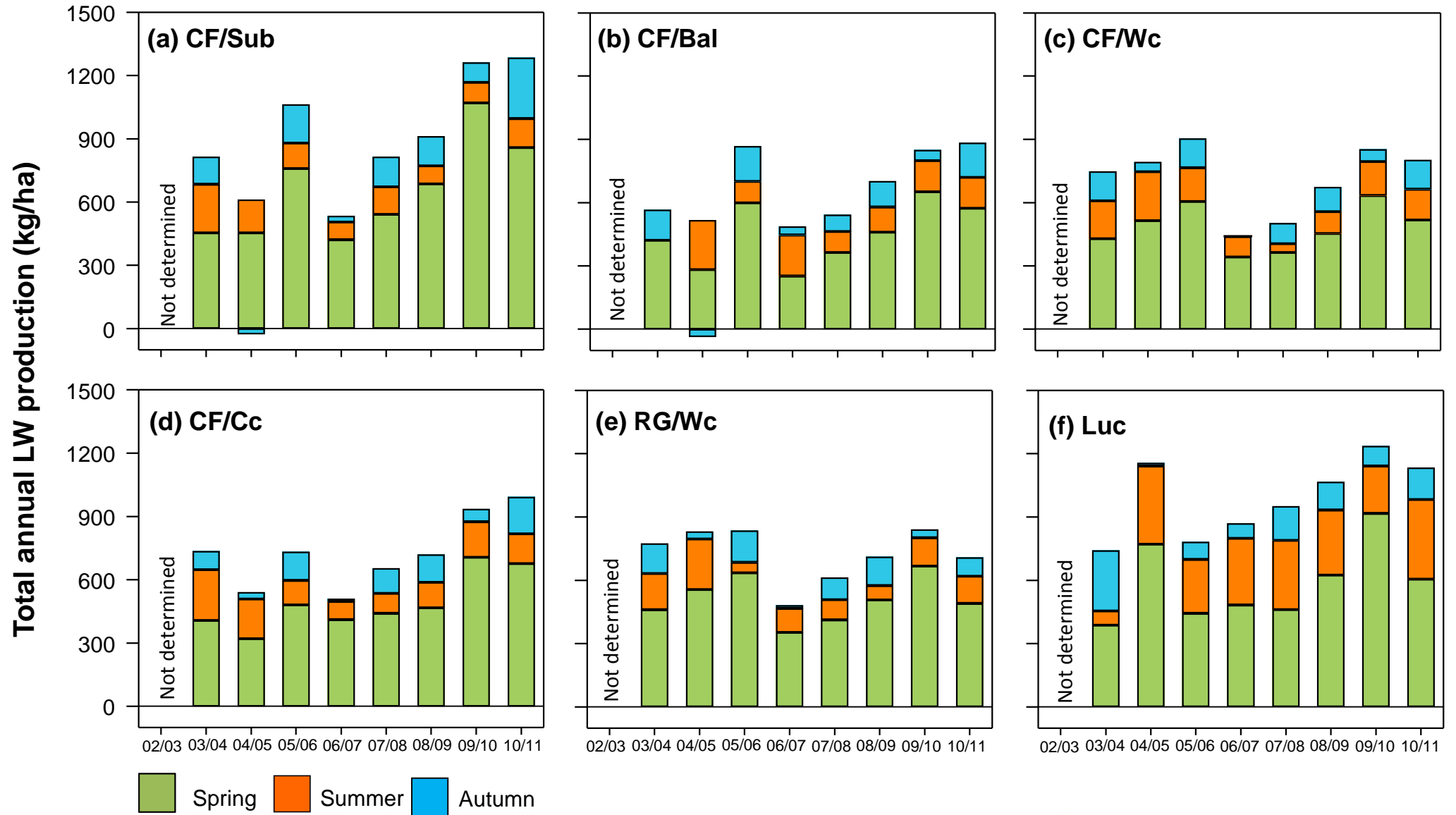
Grass-based pastures underwent a period of set stocking, short (2-paddock) or intermediate (3-paddock) rotational grazing in early spring before being rotationally grazed in a six paddock rotation until insufficient feed supply led to destocking of the pastures (drought or low winter temperatures).

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.

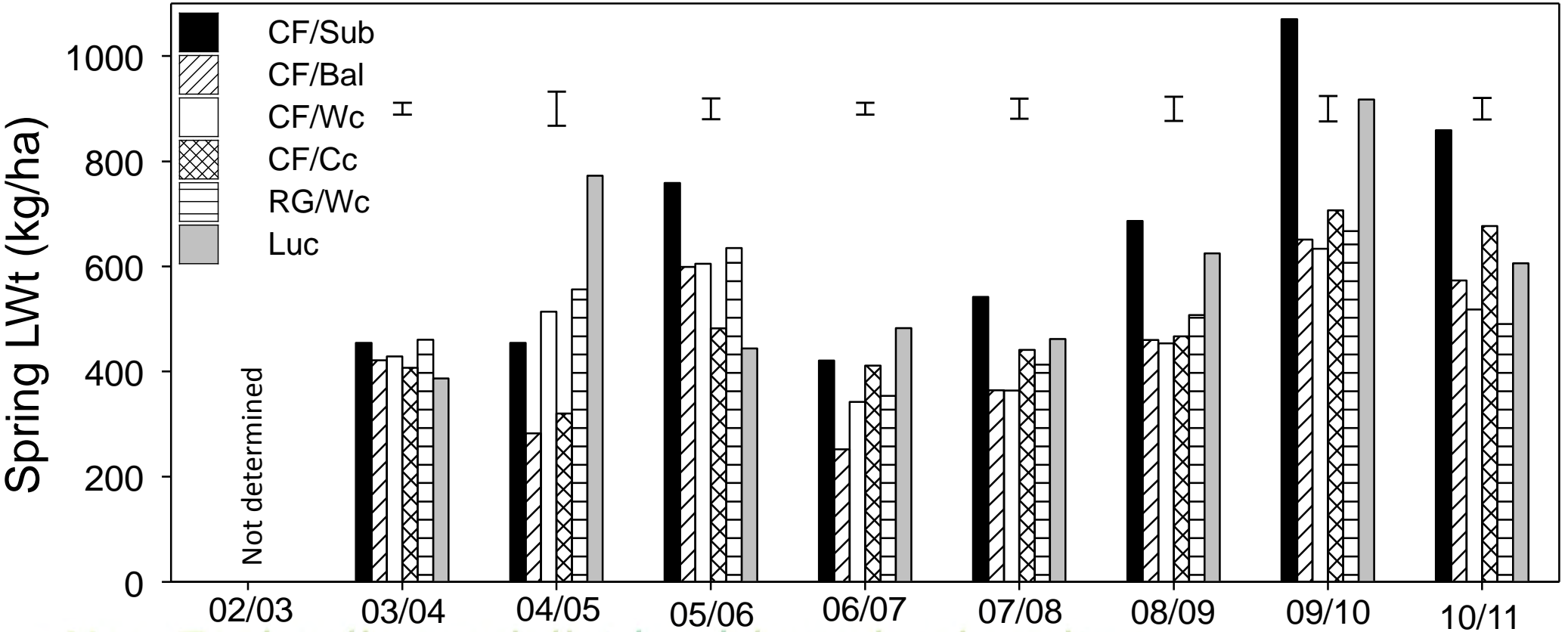
When necessary, ewes were used to hard graze annual clover pastures in early autumn to open the sward in preparation for the germination of annual clover seedlings after autumn rains.

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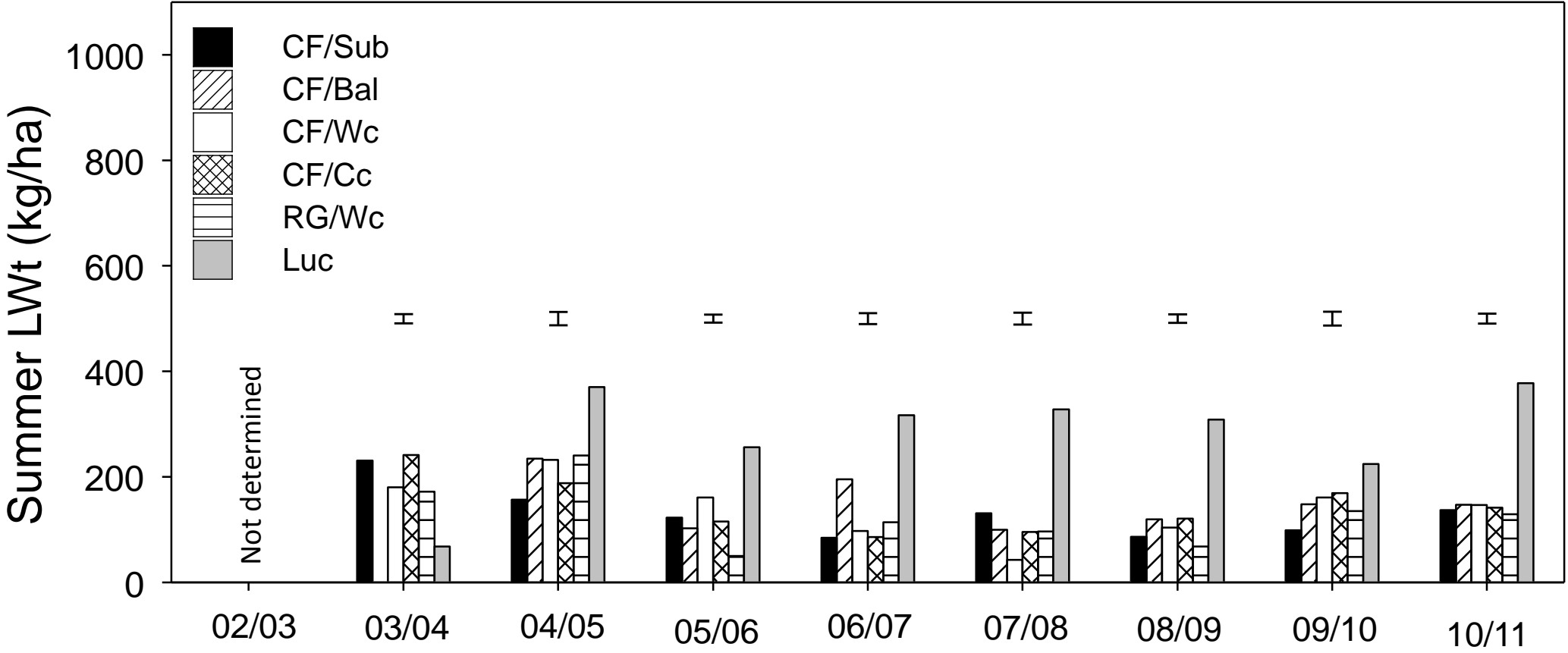


# Total spring LWt production



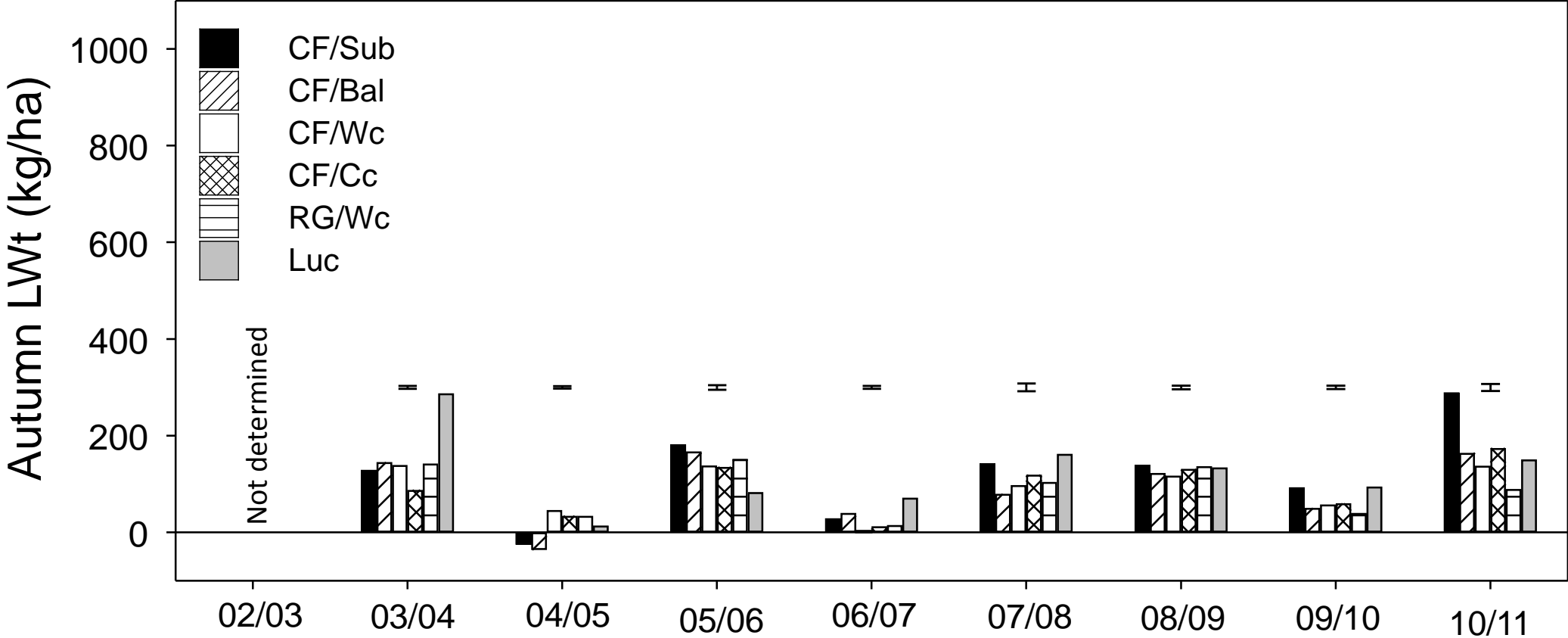
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# Total summer LWt production



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# Total autumn LWt production



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# Yield and composition of six dryland pastures over nine growth seasons

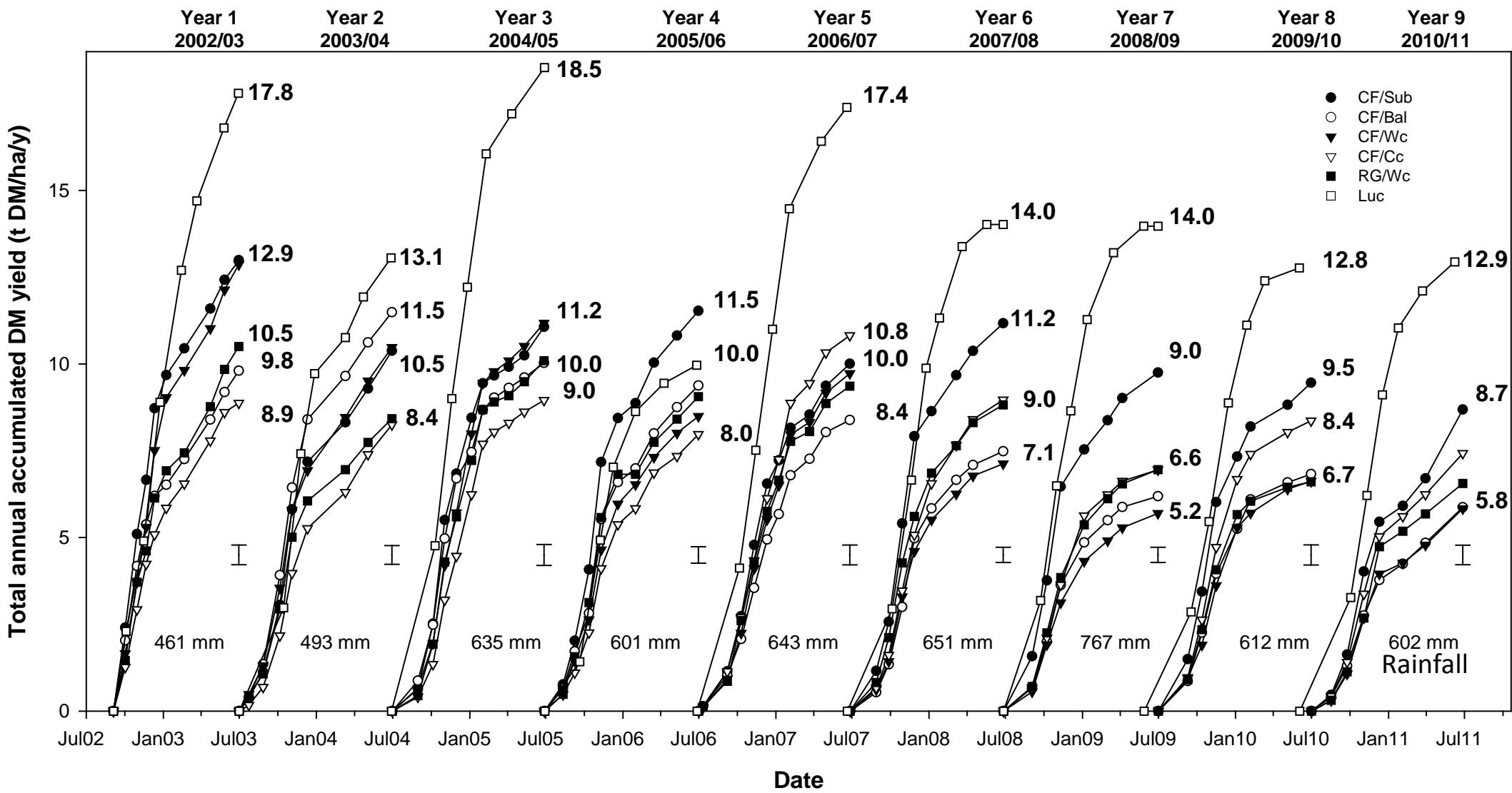


- Lucerne produced more DM than all grass based pastures in most years.
- Its tap-root enabled access to water from lower soil layers but it also used water more efficiently than the grass based pastures - especially in spring.
- CF/Sub clover was the highest yielding grass based pastures in Years 6-9.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

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# Figure 1. Total annual accumulated dry matter production



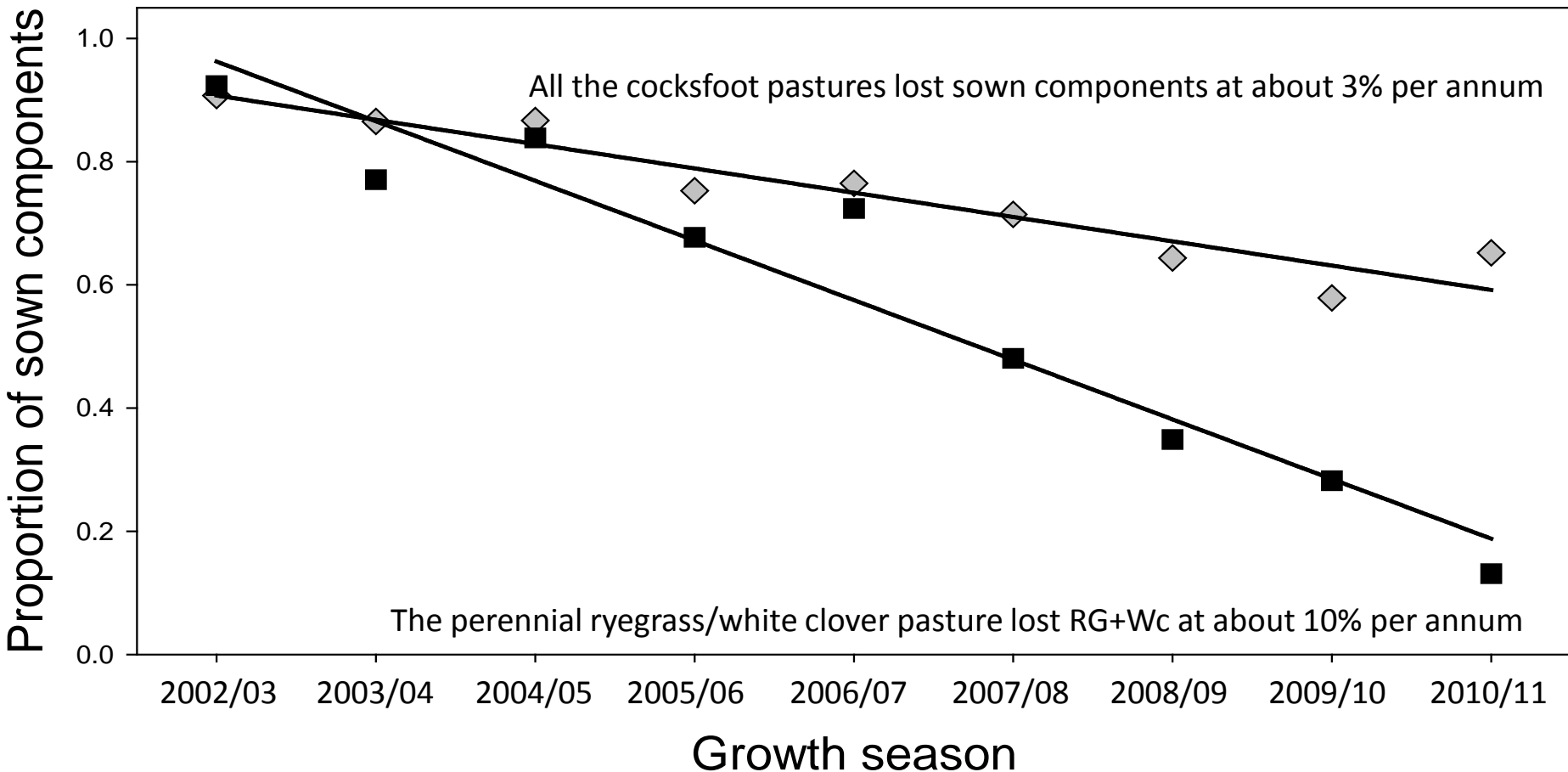
Source: Moot 2012

# 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

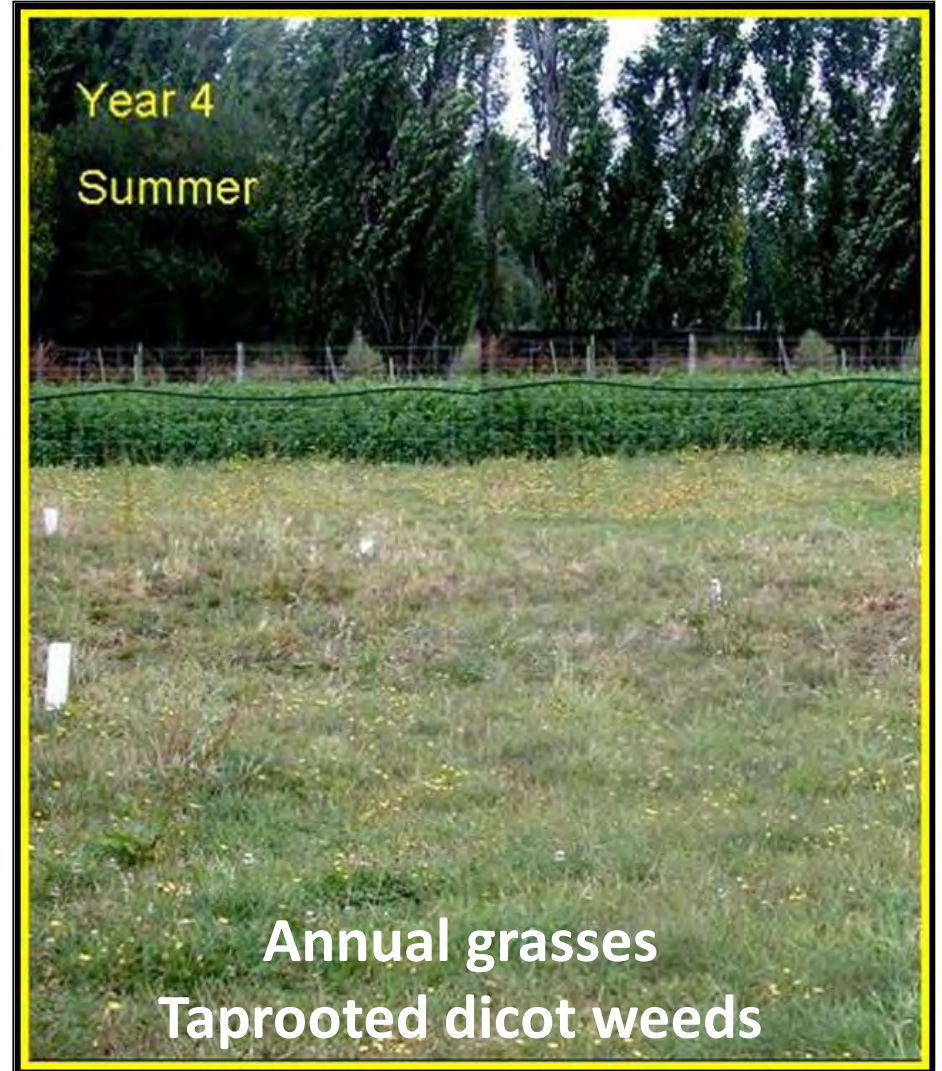
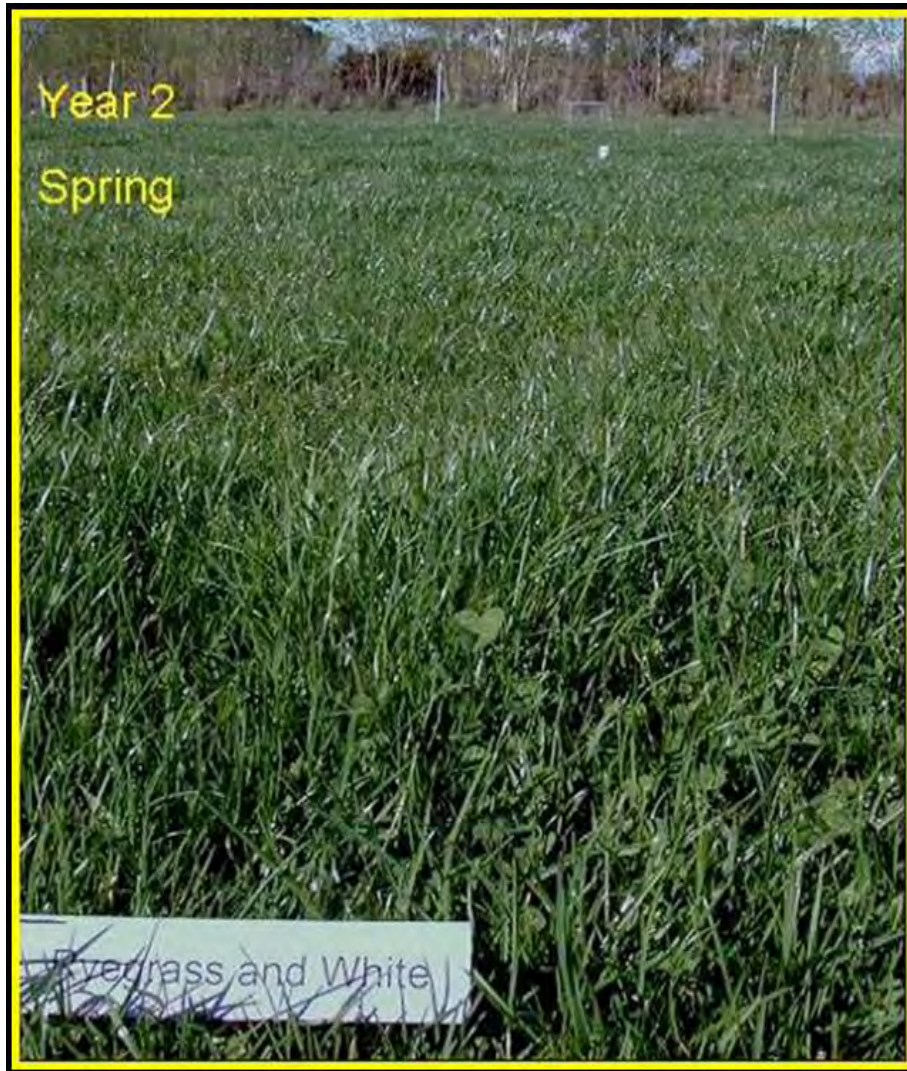


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# Summary of Figure 2



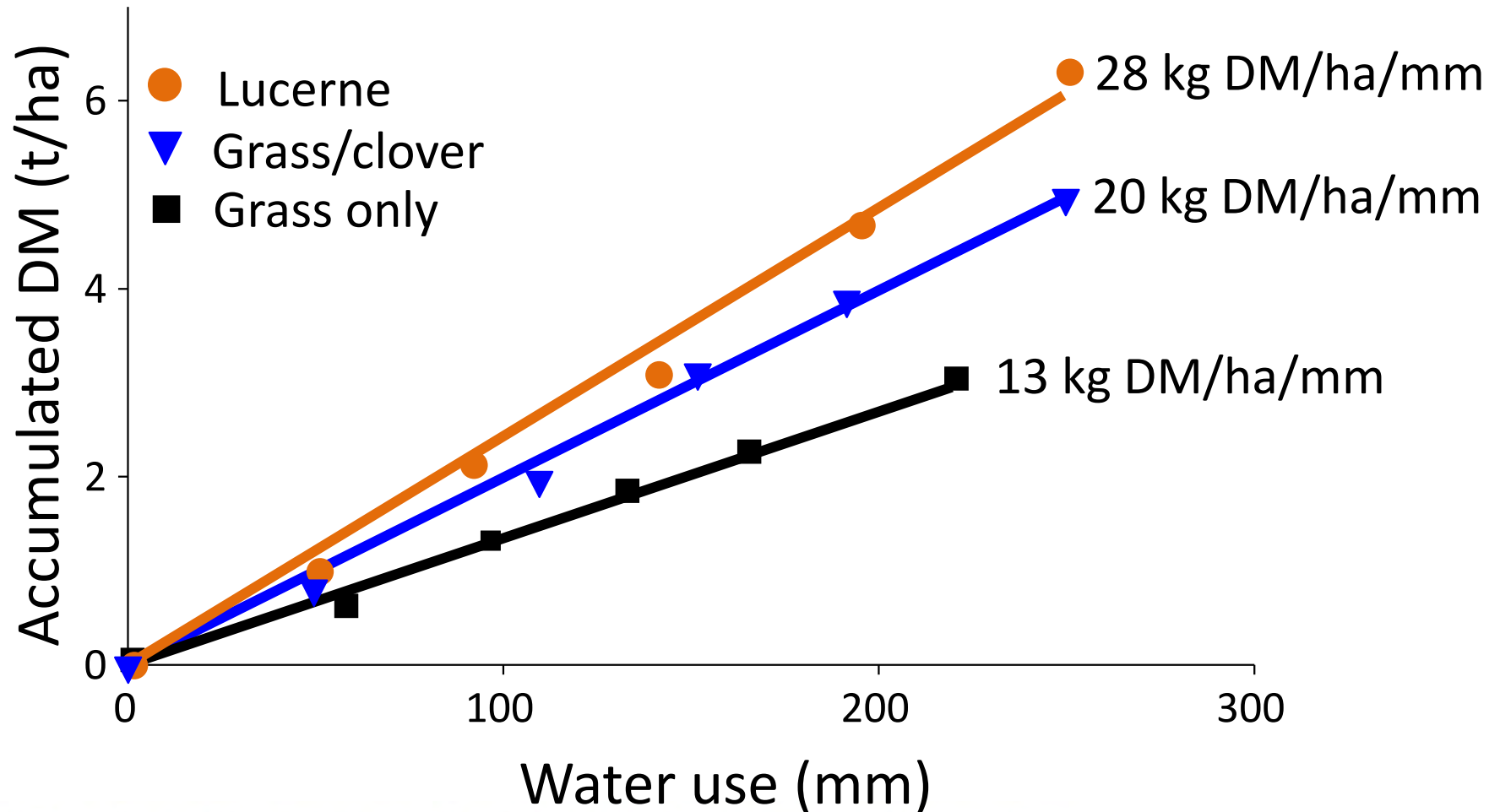
- After 9 years about 10% of the RG/Wc pasture was from originally sown species compared with about 60% in the cocksfoot based pastures. Lucerne (not shown) was about 85% pure due to winter weed control.
- In Years 1-3 the RG/Wc pastures maintained a high proportion of ryegrass and white clover. Most 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



# 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**

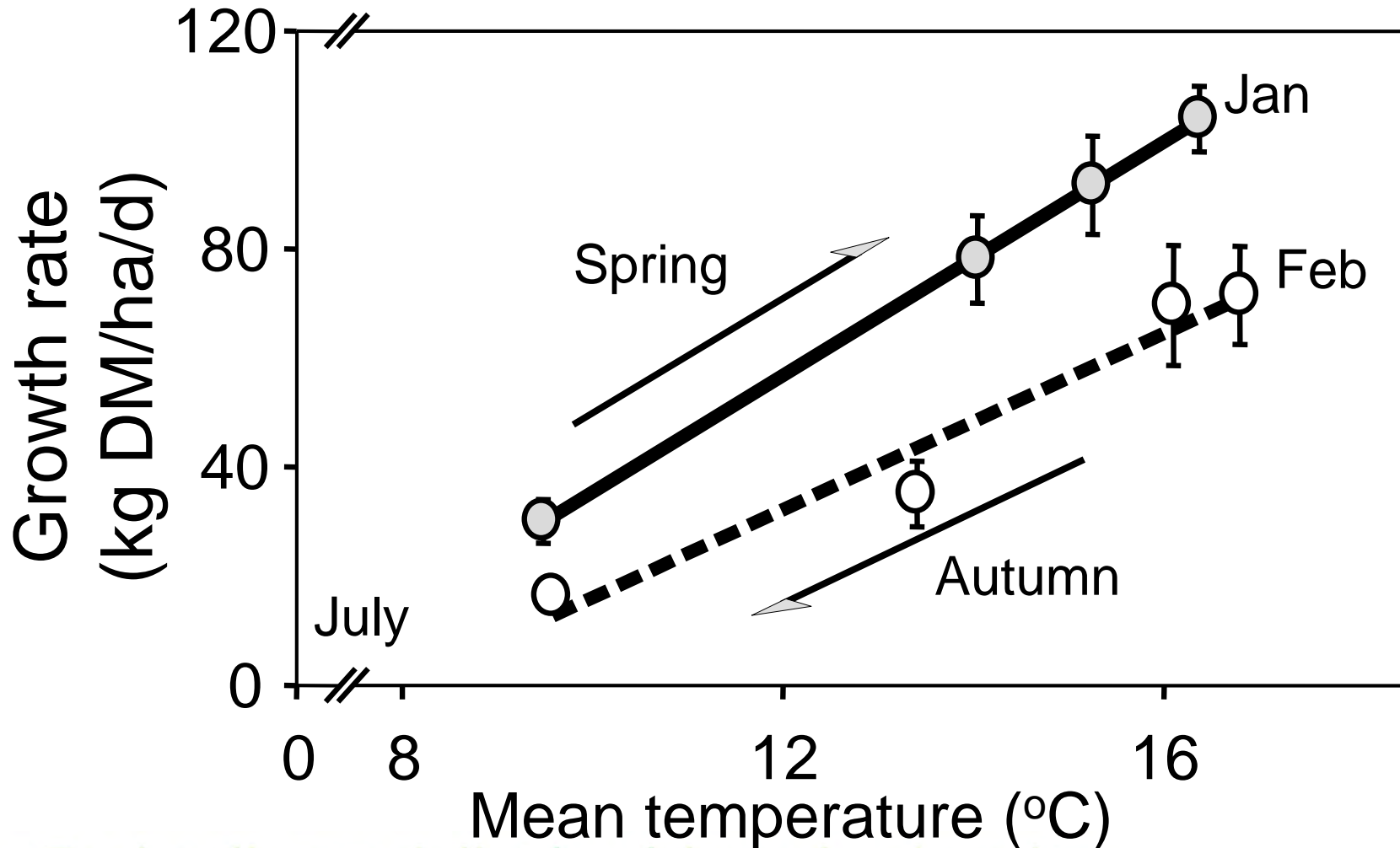




The canopy:  
the energy capture device



# Vegetative growth



# Experiment 2 flexible grazing

38 days resting

4 days grazing



25 days resting

3 days grazing

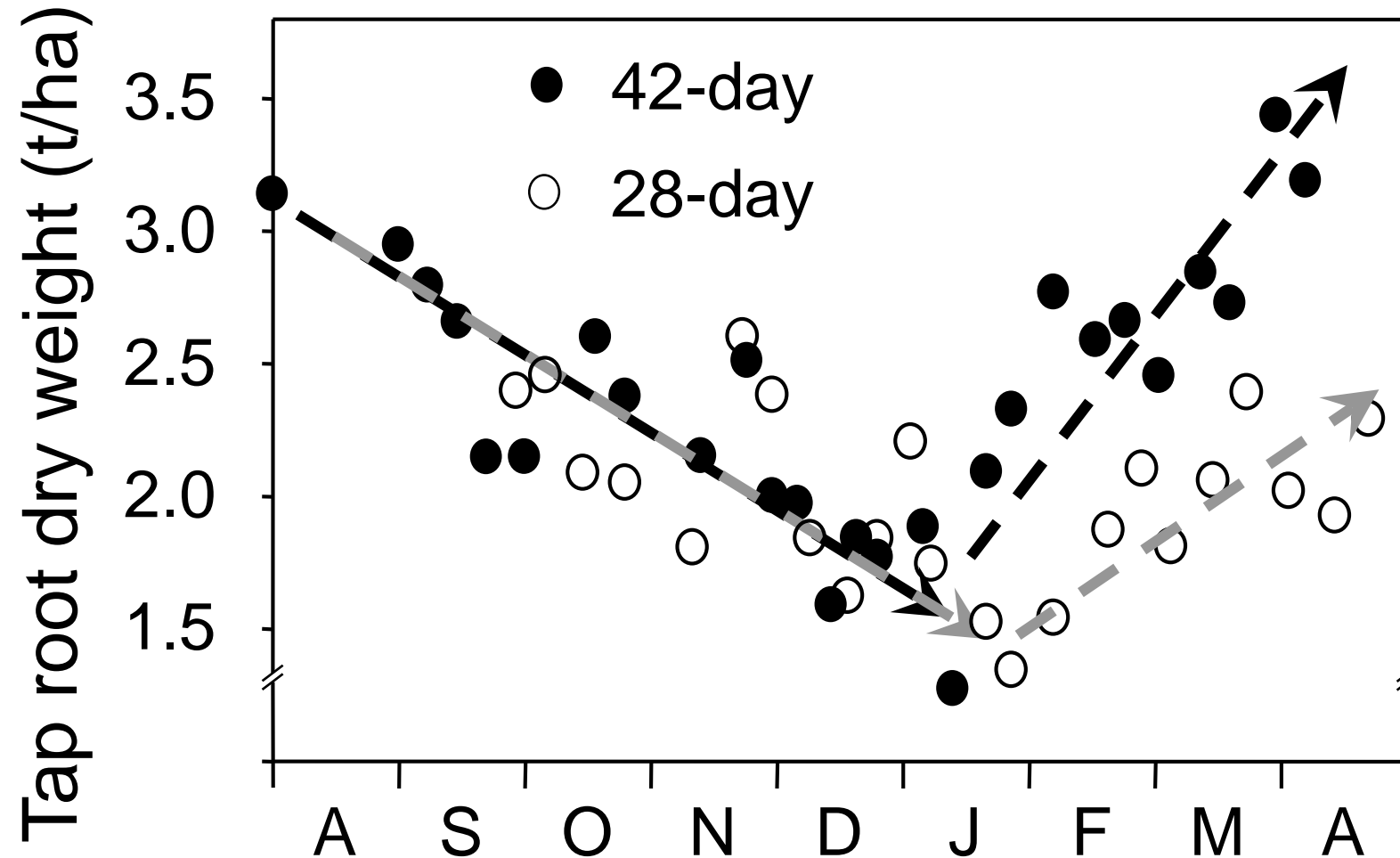




# What's going on down there?



# Partitioning to roots






# Seasonal grazing management

## *Spring*

- 1<sup>st</sup> 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

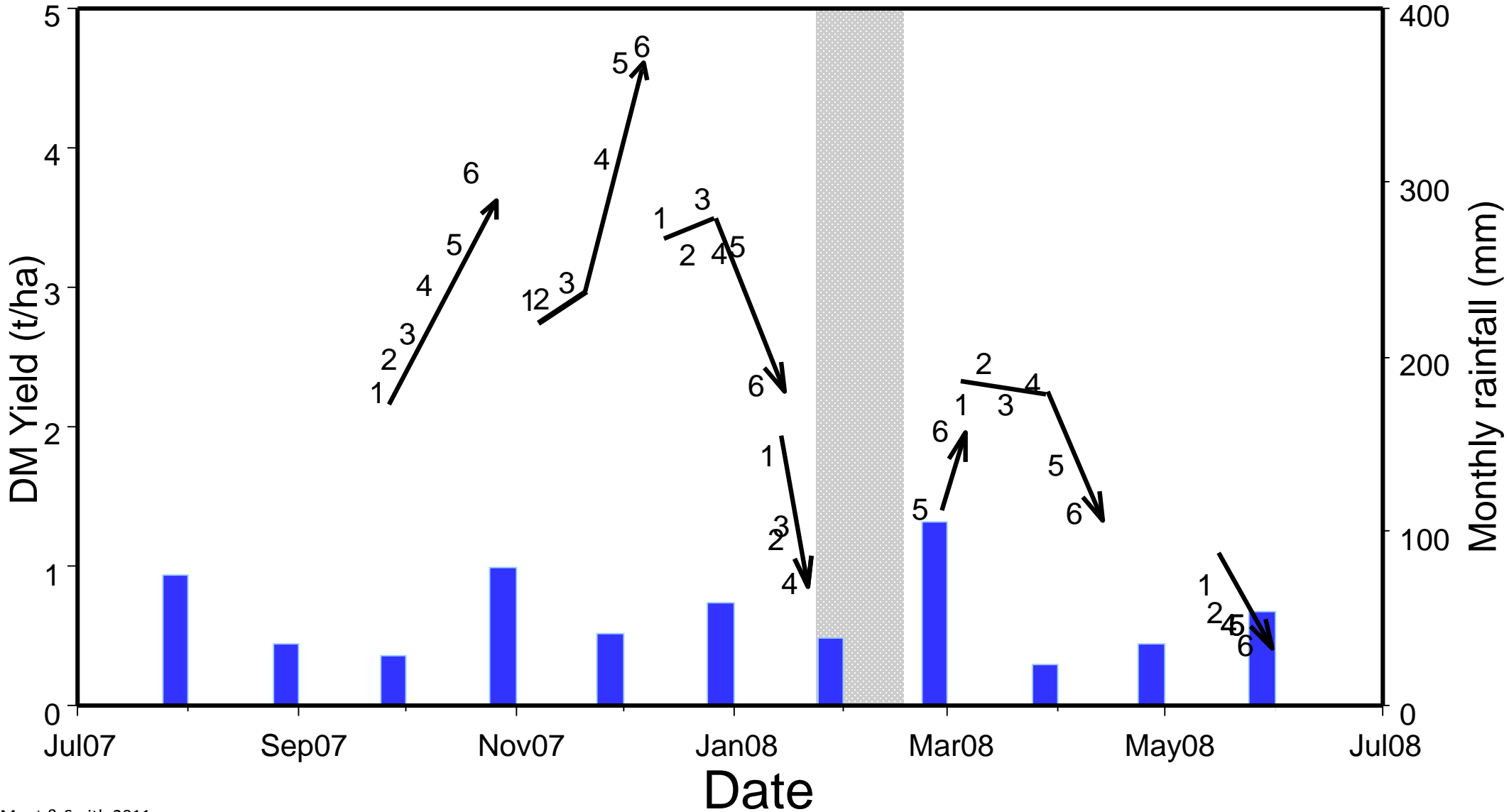
***Growing point at the top of the plant***





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

# MaxClover – 38-42 day rotation





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

Plot 31  
Date: 2/11/07  
Pre-graze







5<sup>th</sup> September 2011 – Cave Sth Canterbury





# 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  $\Rightarrow$  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**



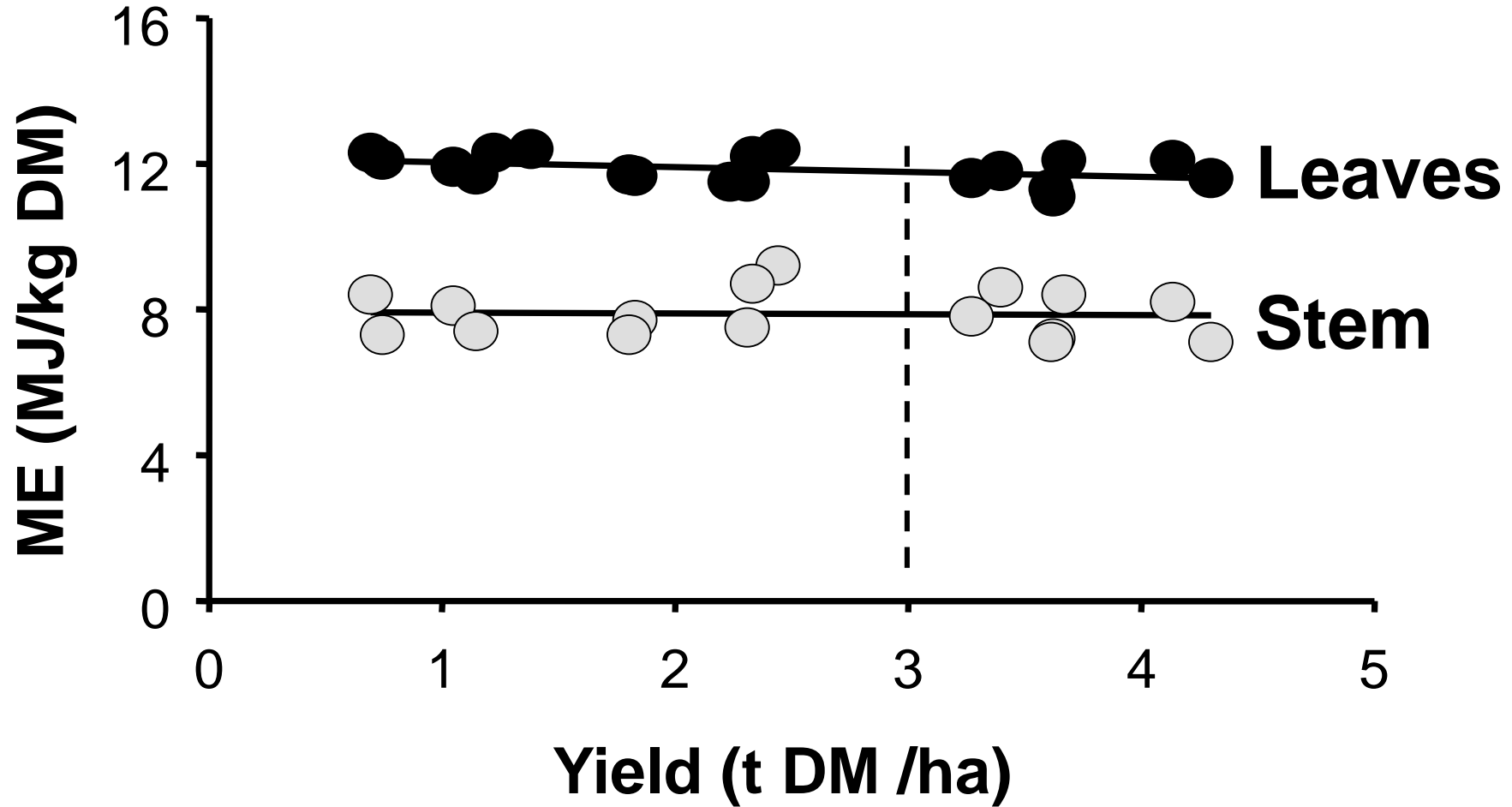
**Autumn = flowering plants  
But don't flush on this!**



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



# Metabolisable energy of lucerne





# 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

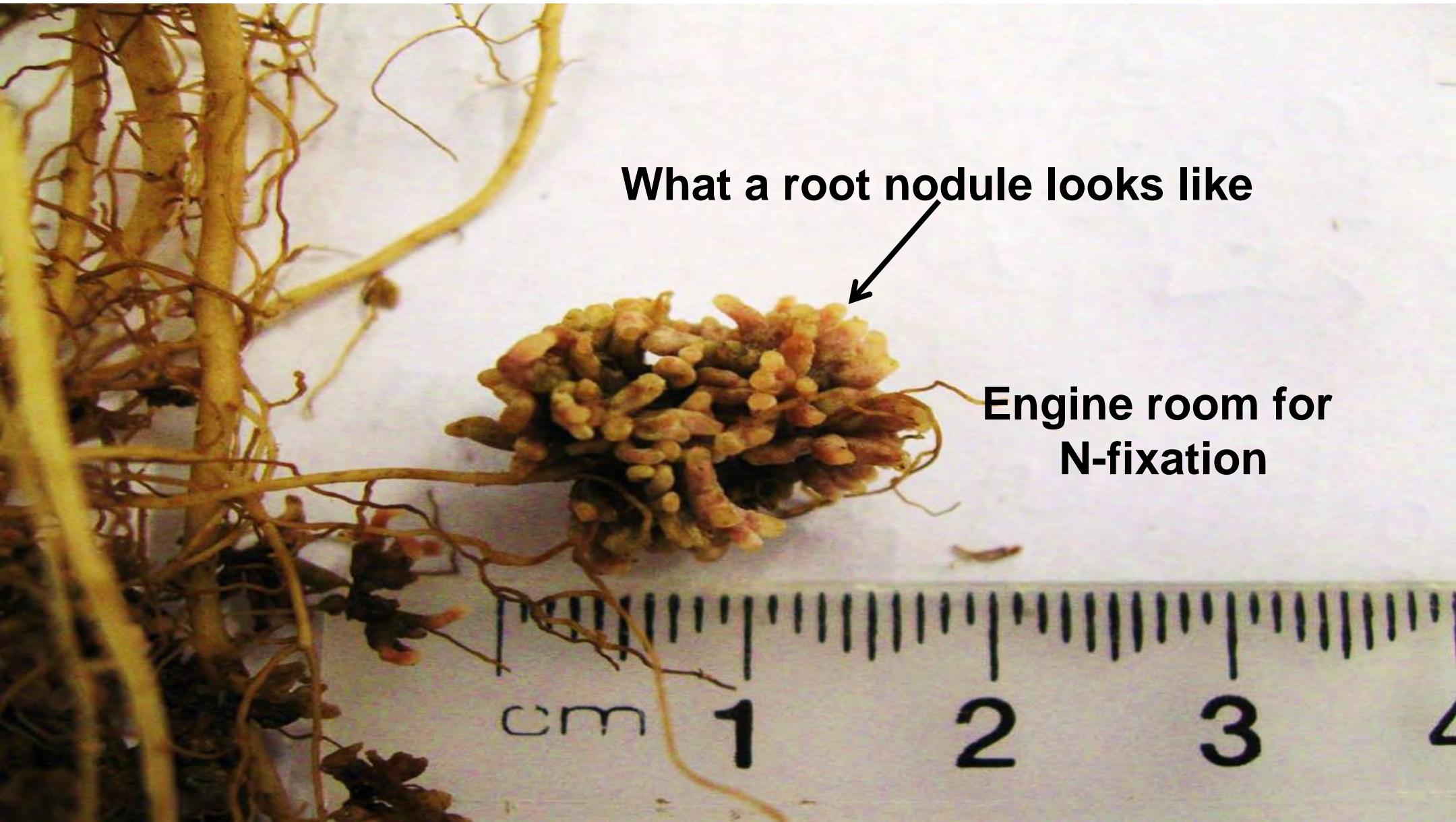
- **Redgut:** problem on high quality feeds – fibre
- **Bloat:** cattle more than sheep – capsules
- **Na def. (0.03%):** salt licks/fence-line weeds/pasture
- Require 0.11% Na - sheep/beef/dairy



# 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**



**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**



Drilling seed with fertiliser  
Direct drilling = seed + fertiliser





# Hills Creek Station

Sown 4/11/2008

Photo taken 5/11/2010



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**Over 60,000 ha sown and doubling of lucerne seed sales over  
10 years**

**“35% Rate of return on investment”**

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# Sowing rate and date

**Established 2007 LU – Templeton silt loam**

**Coated ‘Grasslands Kaituna’ lucerne.**

## **Four sowing dates**

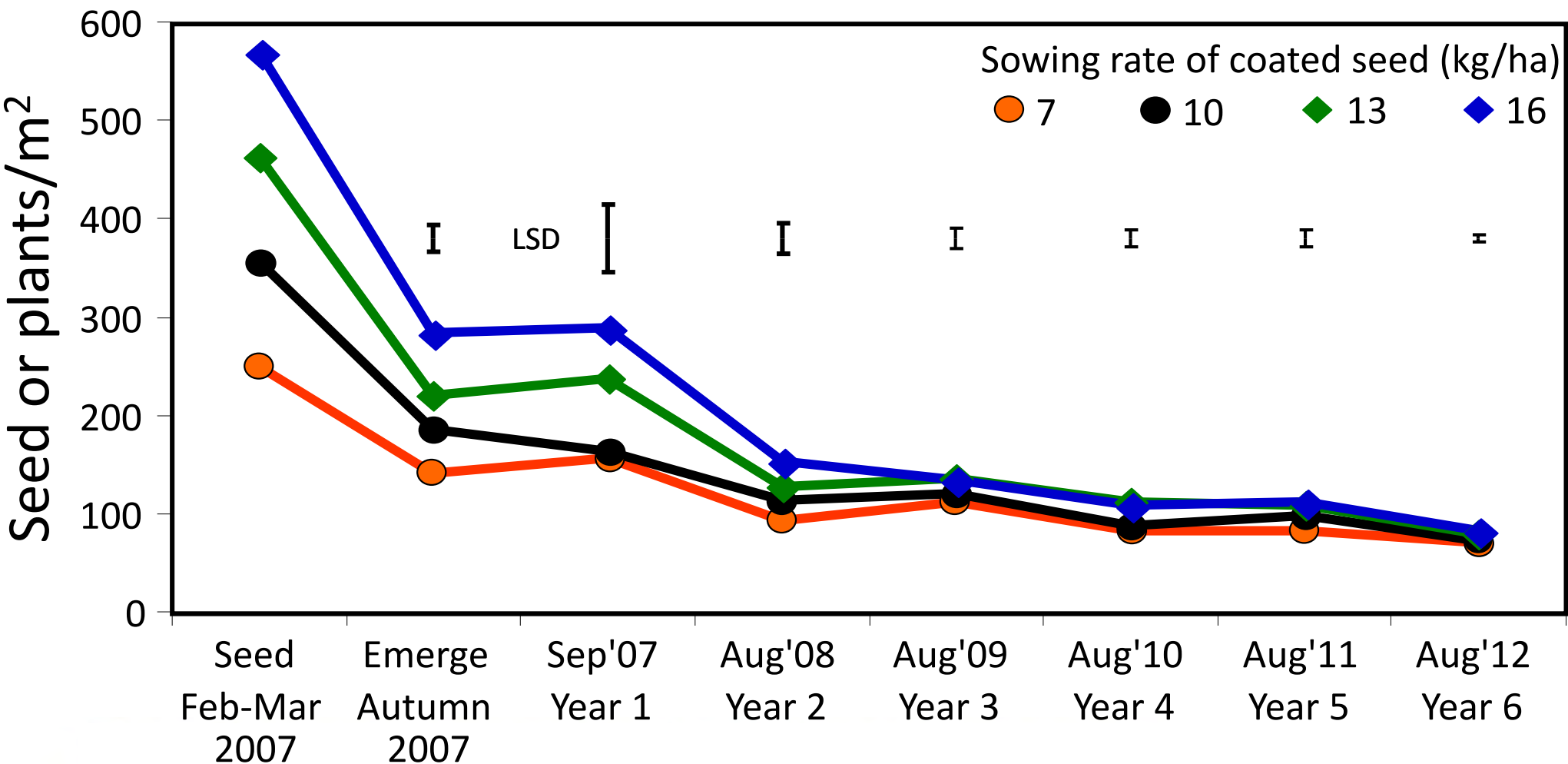
- **21 February,**
- **2 March,**
- **16 March and**
- **30 March**

## **Four sowing rates**

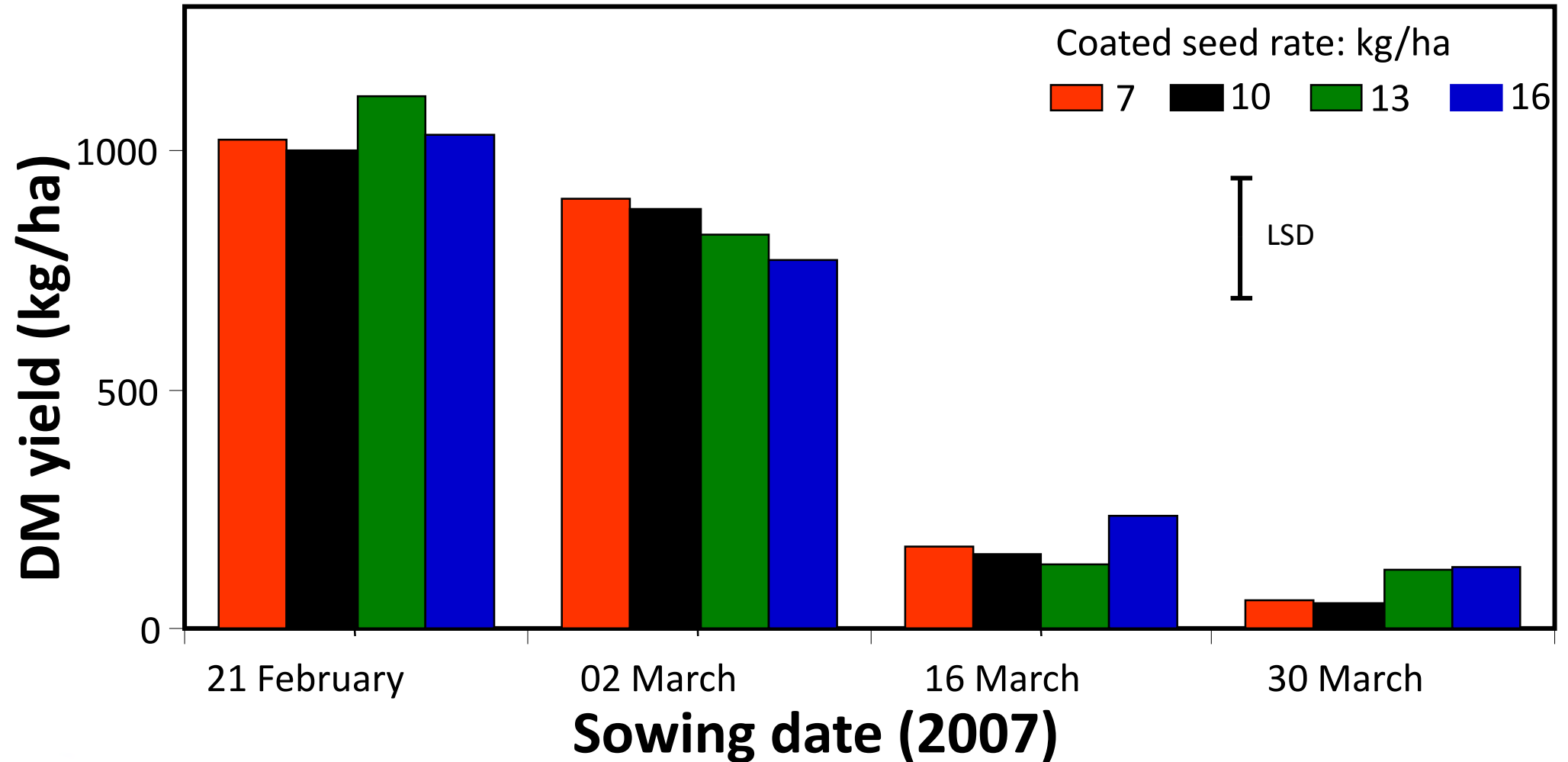
- **Equivalent to bare seed @ 7, 10, 13 and 16 kg/ha**



# Sown seed & plant population over time



# Seedling lucerne yield to early June





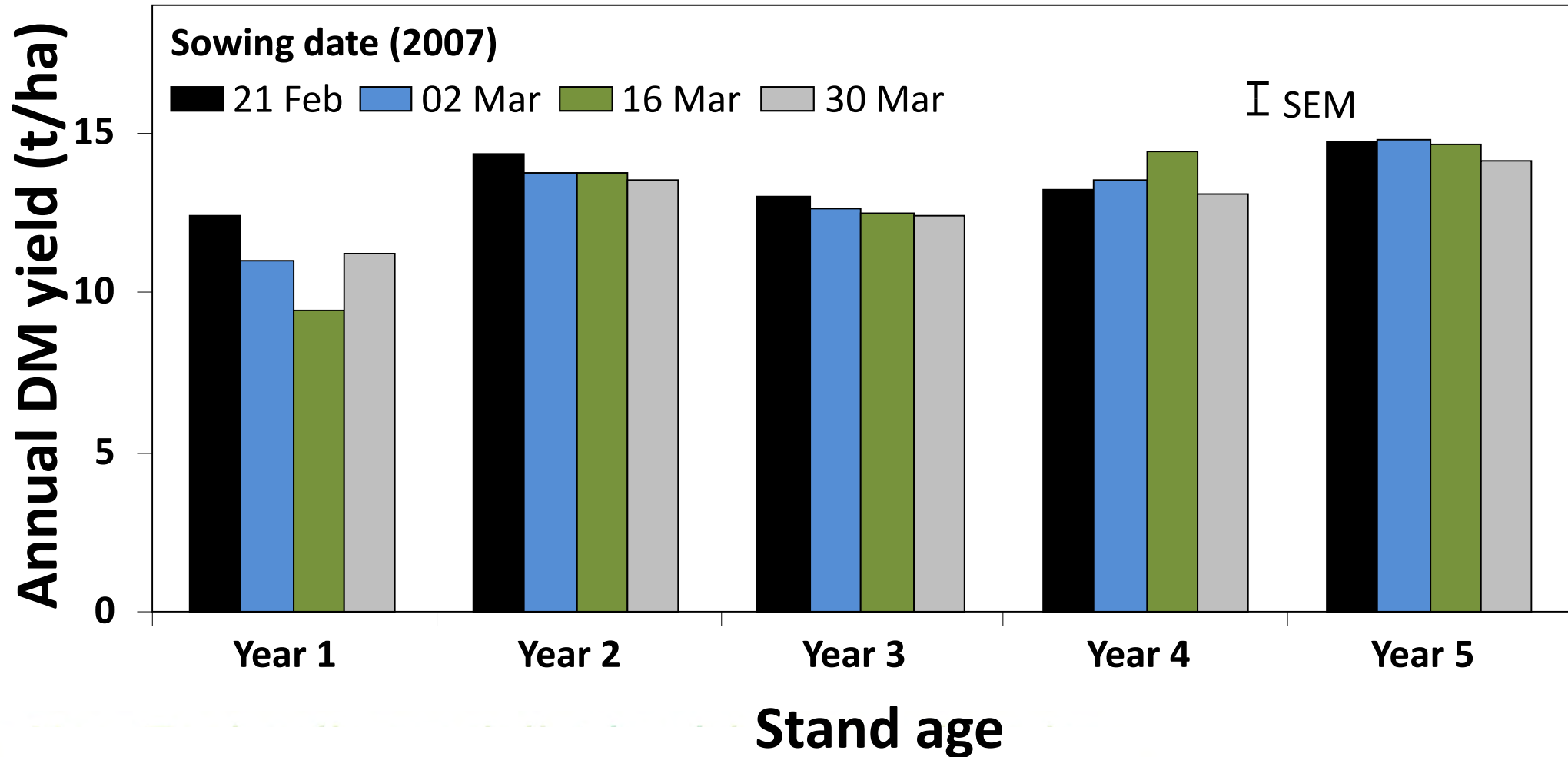
# Weeds present @ 09 October 2007 (Year 1)

Sown 21 Feb 2007

Sown 30 Mar 2007

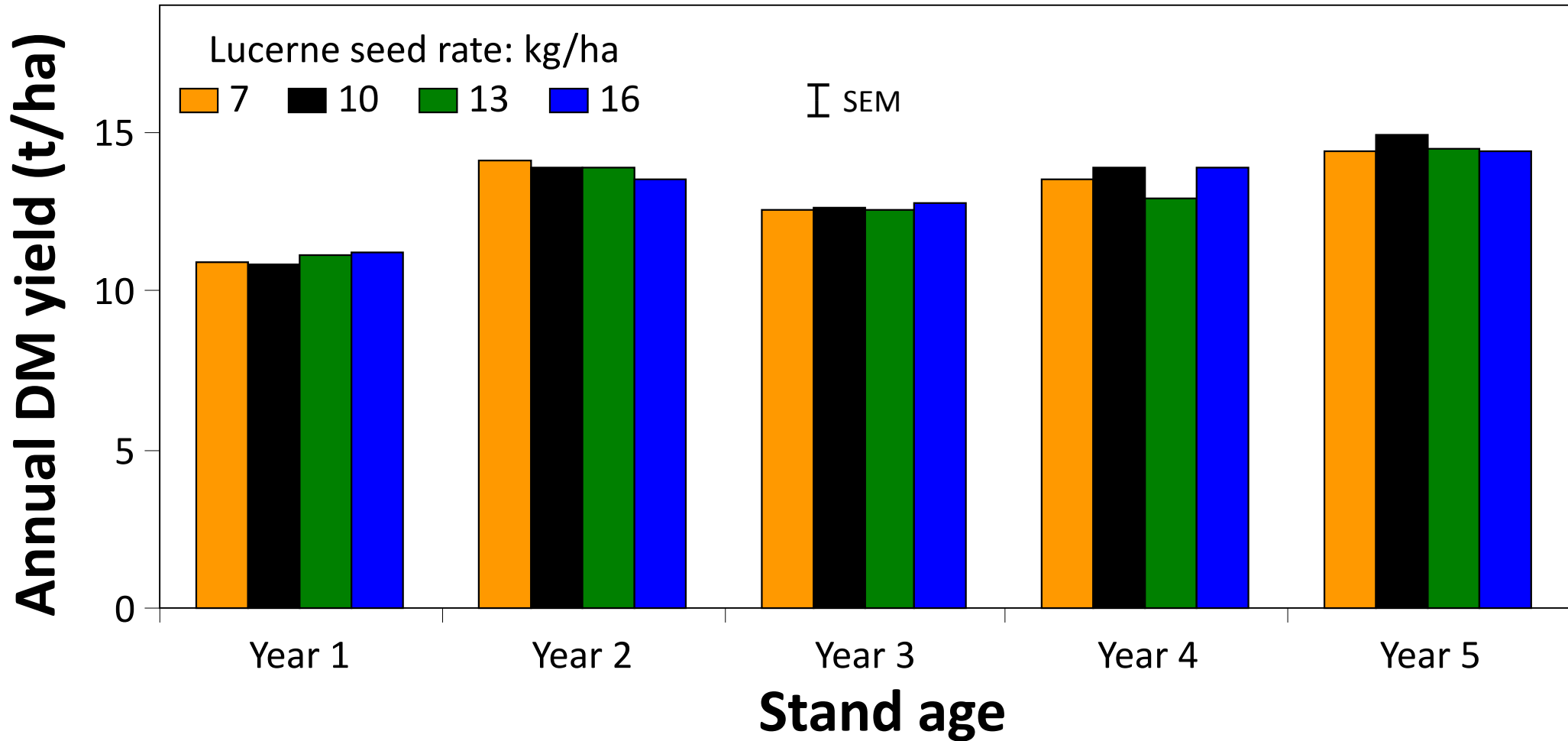


# Annual yield in relation to sowing date





# Annual yield in relation to sowing rate



# 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



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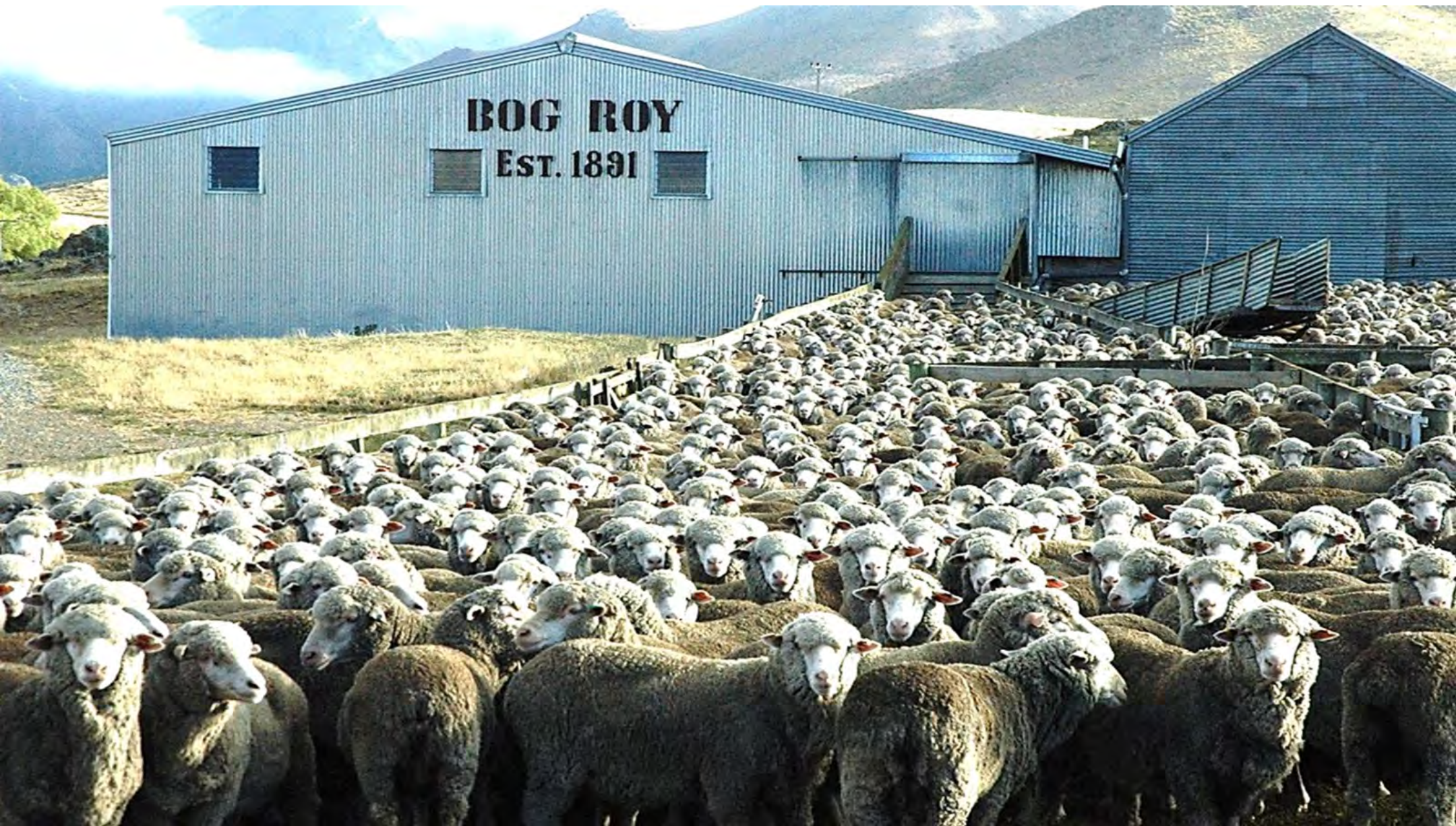


# Integrating lucerne into a high country merino system

D. Anderson, L. Anderson, D.J. Moot and G.I. Ogle

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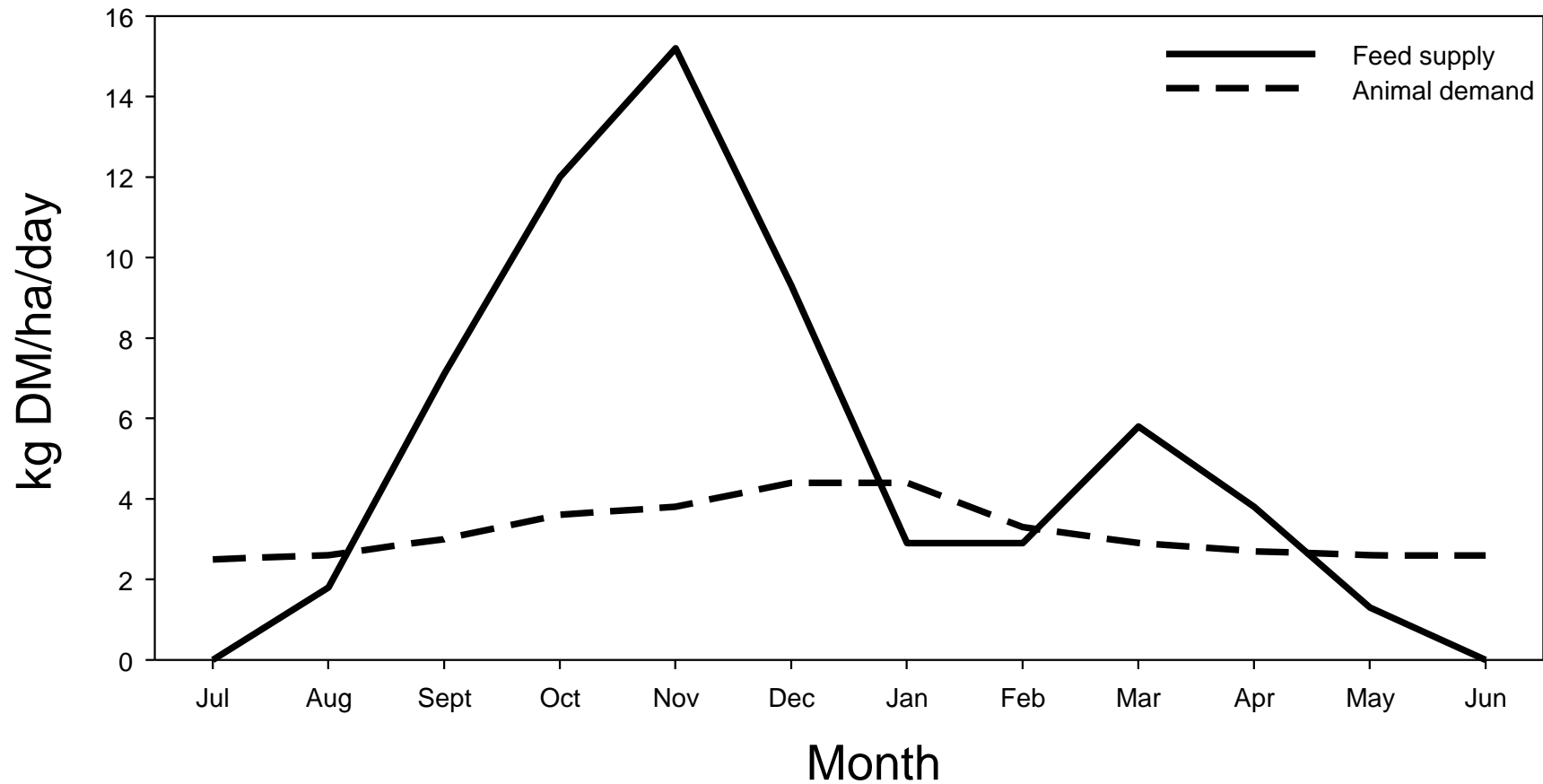


# Landscape farming



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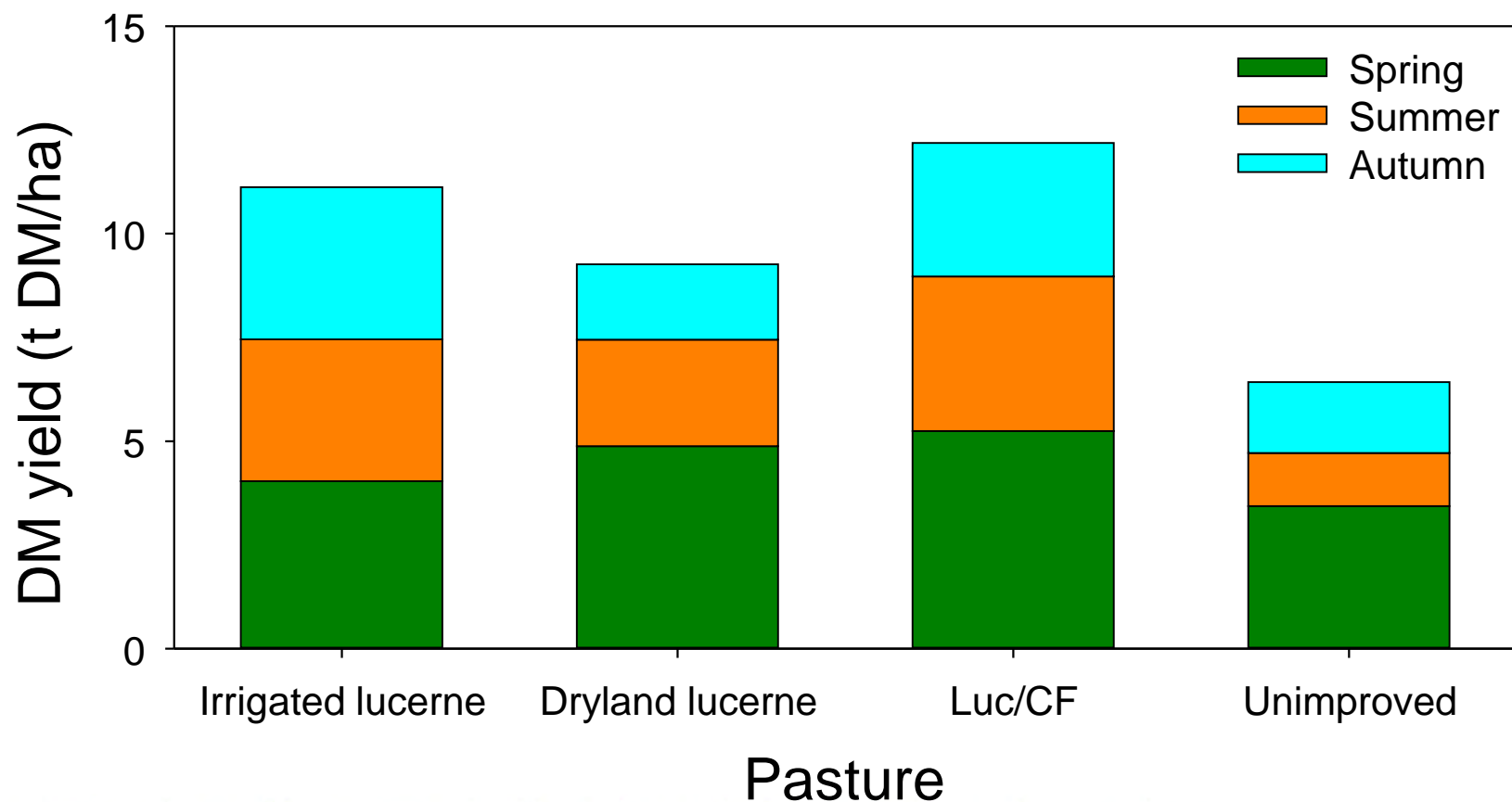
# Pasture supply & Animal demand



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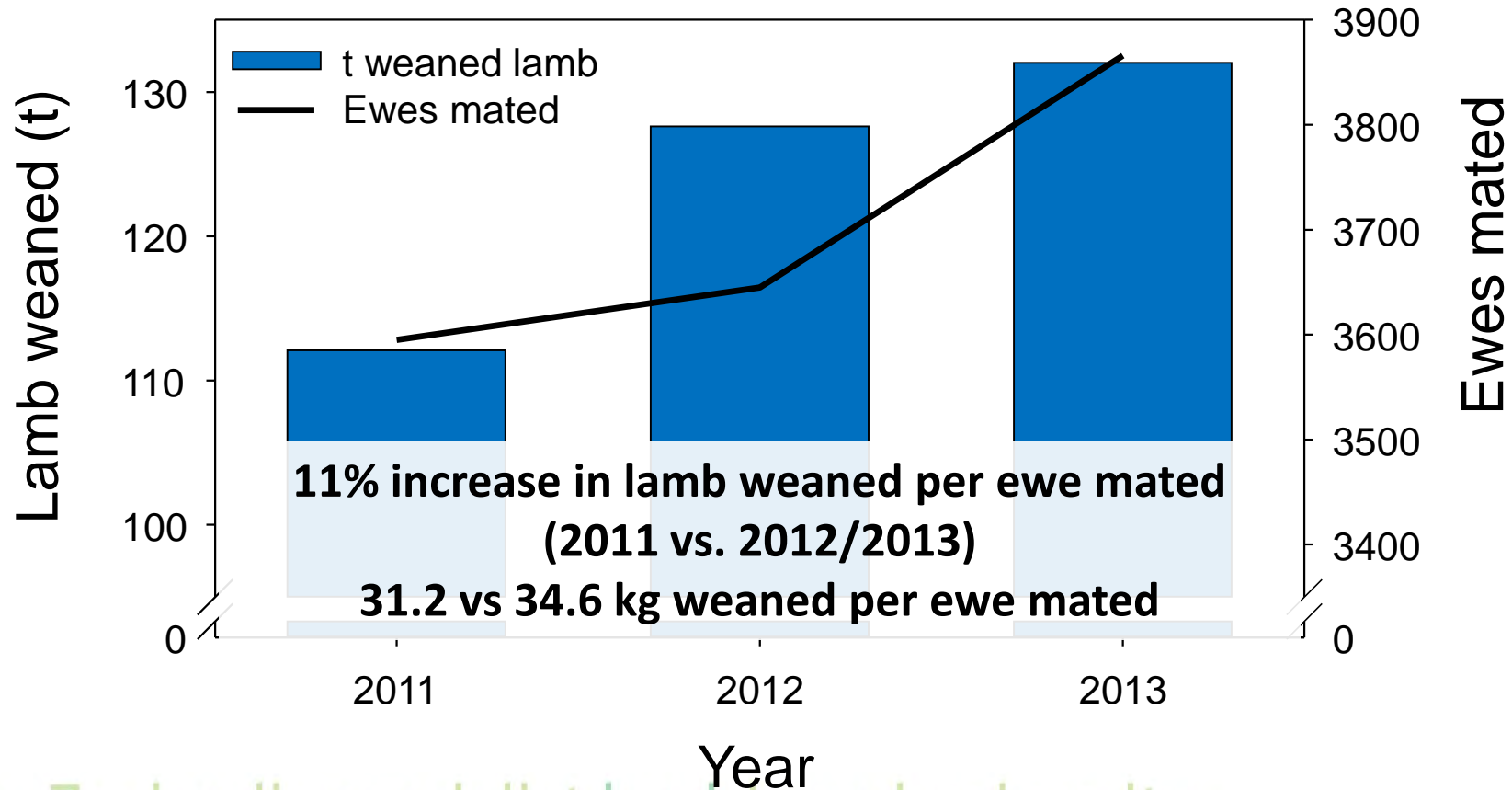


# Seasonal pasture production (3-yr average)



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# Lamb weaned and Ewes mated



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# Bog Roy change in system performance

	Historic (Pre 2010)	Year 3 (target)	Year 3 (actual)	% Change
<b><u>Mixed age ewes</u></b>				
Tupping weight (kg)	57.0	60.0	59.5	↑ 4.3
Ewe scanning (%)	165	165	165	-
Ewe weaning (%)	115	125	130	↑ 13.0
Ewe lamb mortality (%)	30.0	25.0	21.0	↓ -30.0
Lamb weaning weight (kg)	27.0	29.0	29.0	↑ 7.4
Lamb growth rate (g/hd/day)	205	235	235	↑ 14.6

# Case study – Bonavaree farm, Marlborough

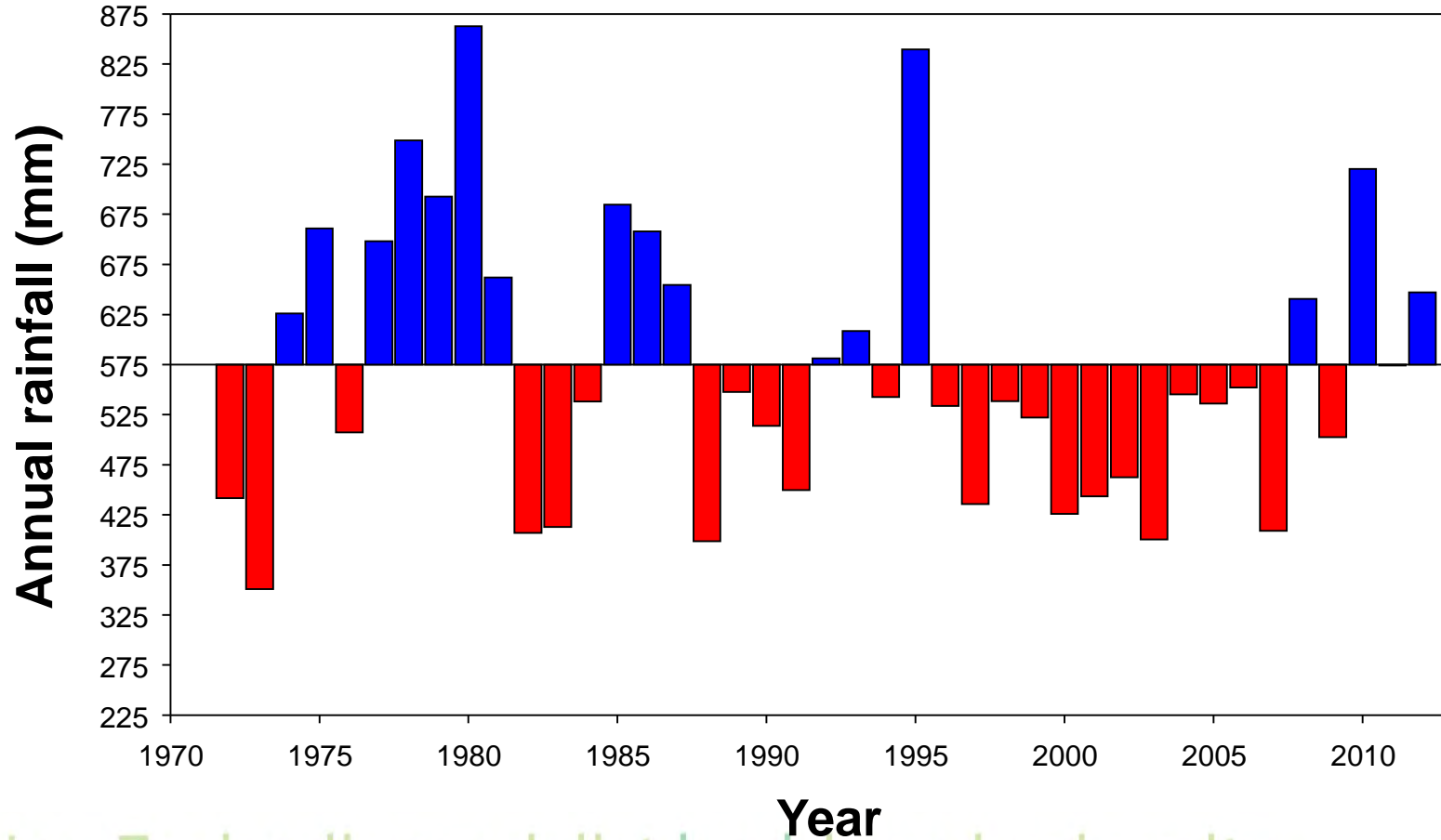
## Over grazed – high erosion risk



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# Annual rainfall at 'Bonavaree'



Long-term Average







**Salt bush**

**Young lucerne**

**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	↑ 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%

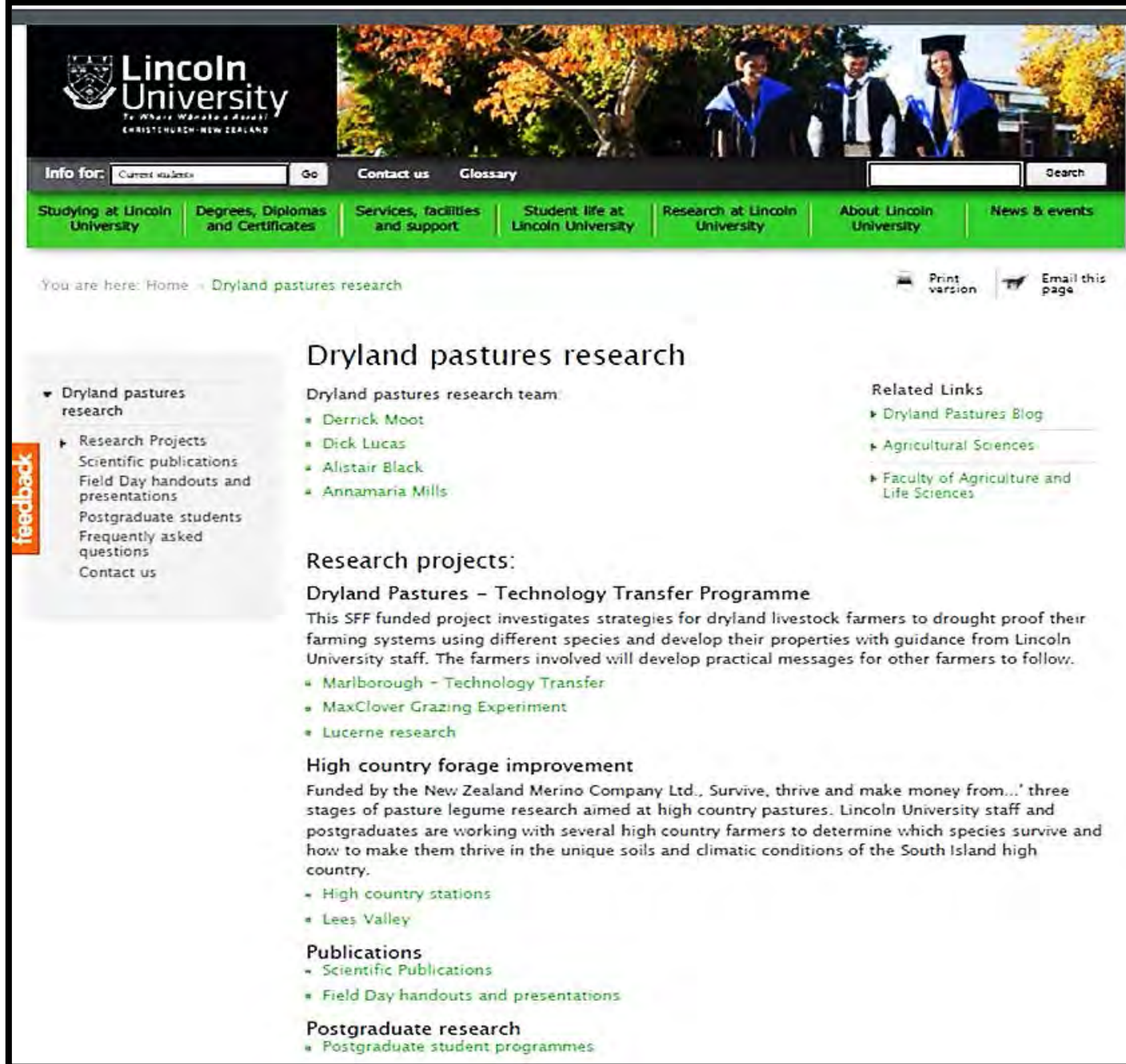
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# The website...

## Info on:

- Current projects
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You are here: Home > Dryland pastures research Print version Email this page

### Dryland pastures research

**Dryland pastures research team:**

- [Derrick Moot](#)
- [Dick Lucas](#)
- [Alistair Black](#)
- [Annamaria Mills](#)

**Research projects:**

**Dryland Pastures – Technology Transfer Programme**

This SFF funded project investigates strategies for dryland livestock farmers to drought proof their farming systems using different species and develop their properties with guidance from Lincoln University staff. The farmers involved will develop practical messages for other farmers to follow.

- [Marlborough – Technology Transfer](#)
- [MaxClover Grazing Experiment](#)
- [Lucerne research](#)

**High country forage improvement**

Funded by the New Zealand Merino Company Ltd., 'Survive, thrive and make money from...' three stages of pasture legume research aimed at high country pastures. Lincoln University staff and postgraduates are working with several high country farmers to determine which species survive and how to make them thrive in the unique soils and climatic conditions of the South Island high country.

- [High country stations](#)
- [Lees Valley](#)

**Publications**

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- [Field Day handouts and presentations](#)

**Postgraduate research**

- [Postgraduate student programmes](#)

**Related Links**

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- [Agricultural Sciences](#)
- [Faculty of Agriculture and Life Sciences](#)

**feedback**

**Dryland pastures research**

- [Research Projects](#)
- [Scientific publications](#)
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[www.lincoln.ac.nz/dryland](http://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



# References & Links



Lincoln University Dryland Pastures Website: <http://www.Lincoln.ac.nz/dryland>

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

[MaxClover Photo Diary](#) (18 MB; PDF File)

- 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).
- Brown H.E., 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.
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- 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.
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