



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



Dryland Pastures Update - Invermay

4 September 2014

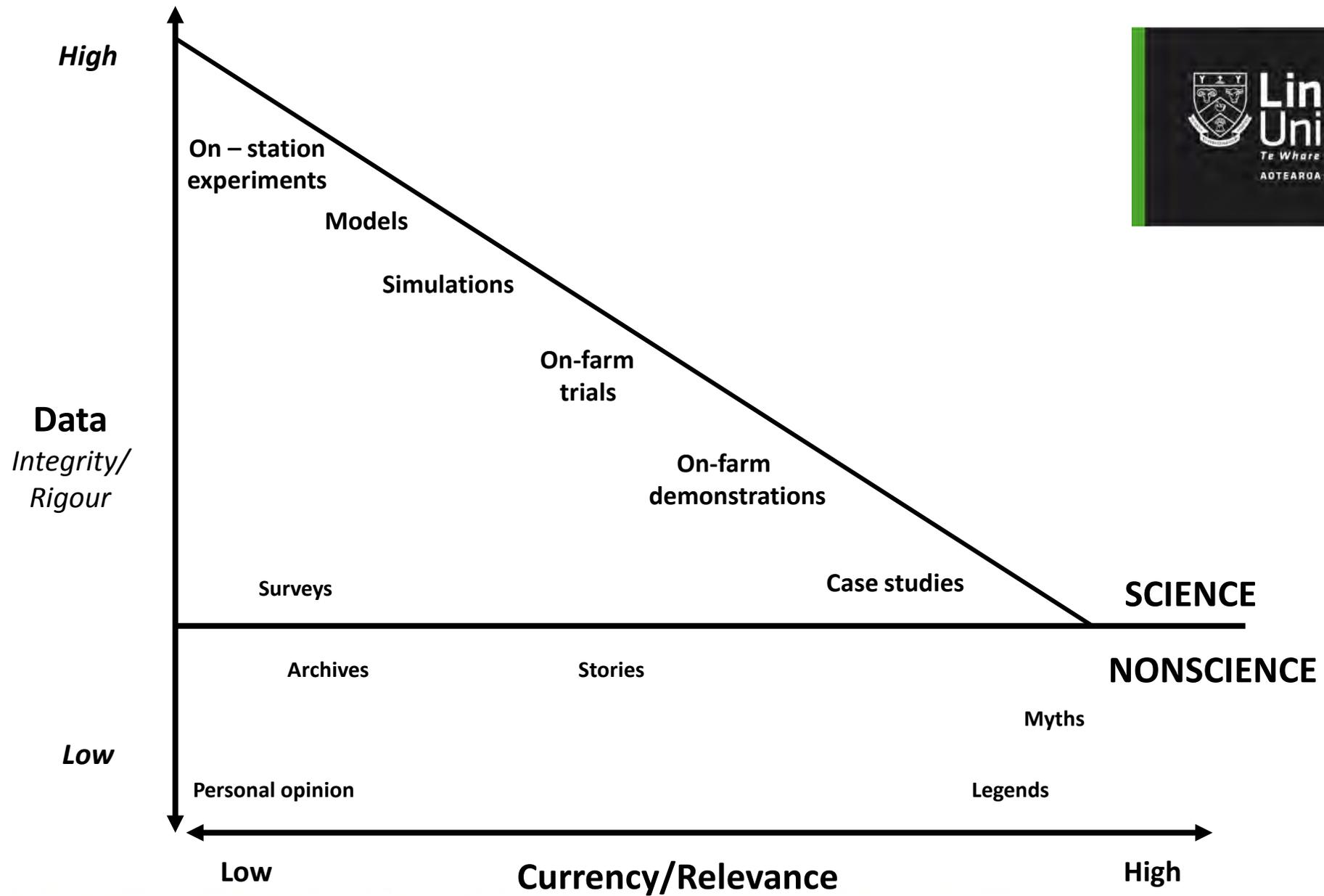
Dr Derrick Moot

Professor of Plant Science, Lincoln University

New Zealand's specialist land-based university

Funded by:





New Zealand's specialist land-based university

Topics

- MaxClover photo diary
- Perennial ryegrass
- White clover
- Annual clovers
- Lucerne establishment
- Lucerne grazing management
- Current research projects

New Zealand's specialist land-based university

The website...

Info on:

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

www.lincoln.ac.nz/dryland

The screenshot shows the Lincoln University website for the 'Dryland pastures research' page. The header includes the university logo and navigation links like 'Info for: Current students', 'Contact us', and 'Glossary'. A green navigation bar lists various university services. The main content area is titled 'Dryland pastures research' and includes a 'Dryland pastures research team' list, 'Research projects' (with 'MaxClover Grazing Experiment' circled), and 'High country forage improvement' details. A 'Related Links' section on the right has 'Dryland Pastures Blog' circled. A left sidebar contains a 'feedback' button and a menu with 'Field Day handouts and presentations' circled. Red arrows connect the list items in the left sidebar to their corresponding elements on the website.



**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

Funded by:



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

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.



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

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

Grazing management



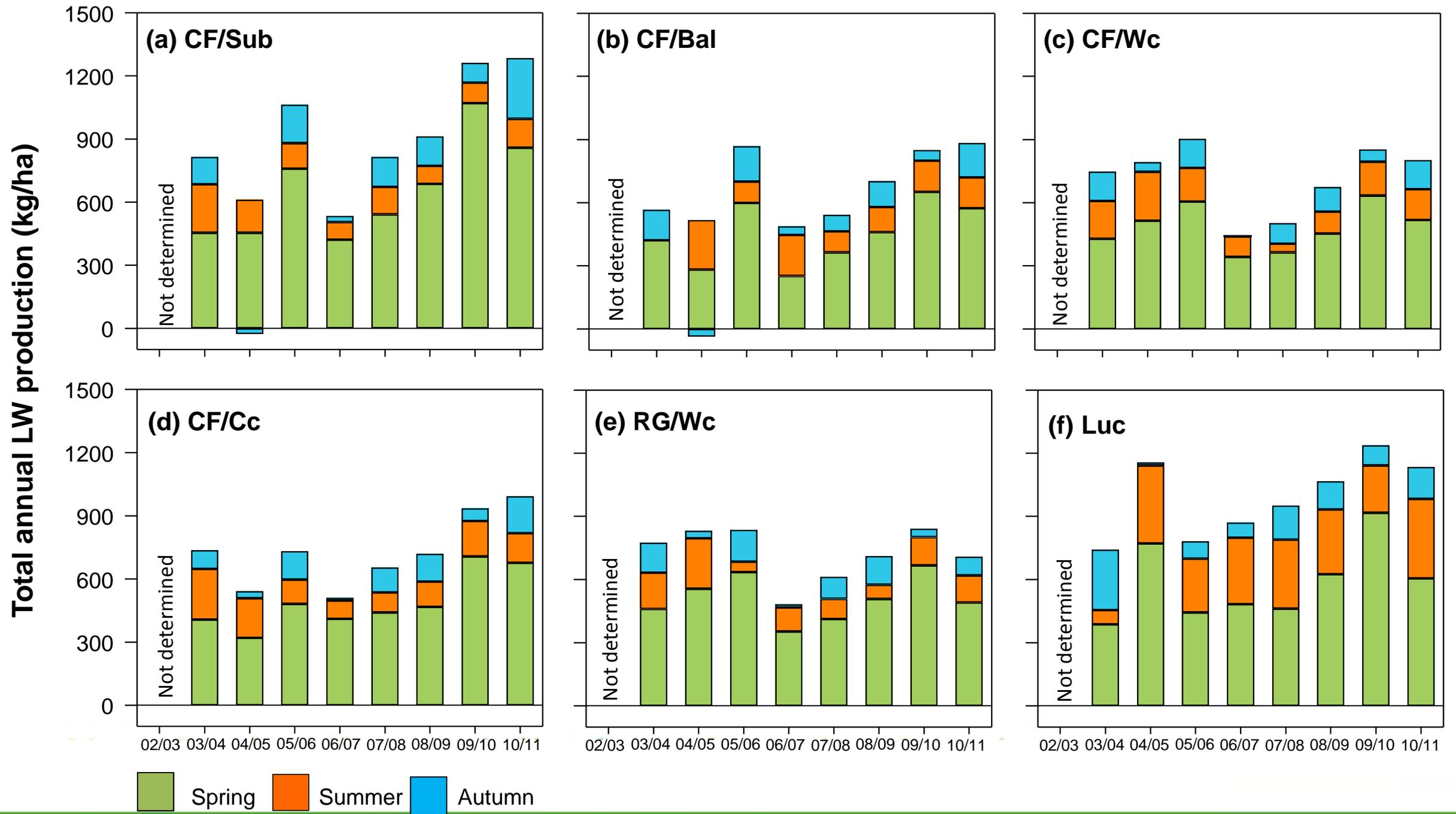
Lucerne was always rotationally grazed.

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).

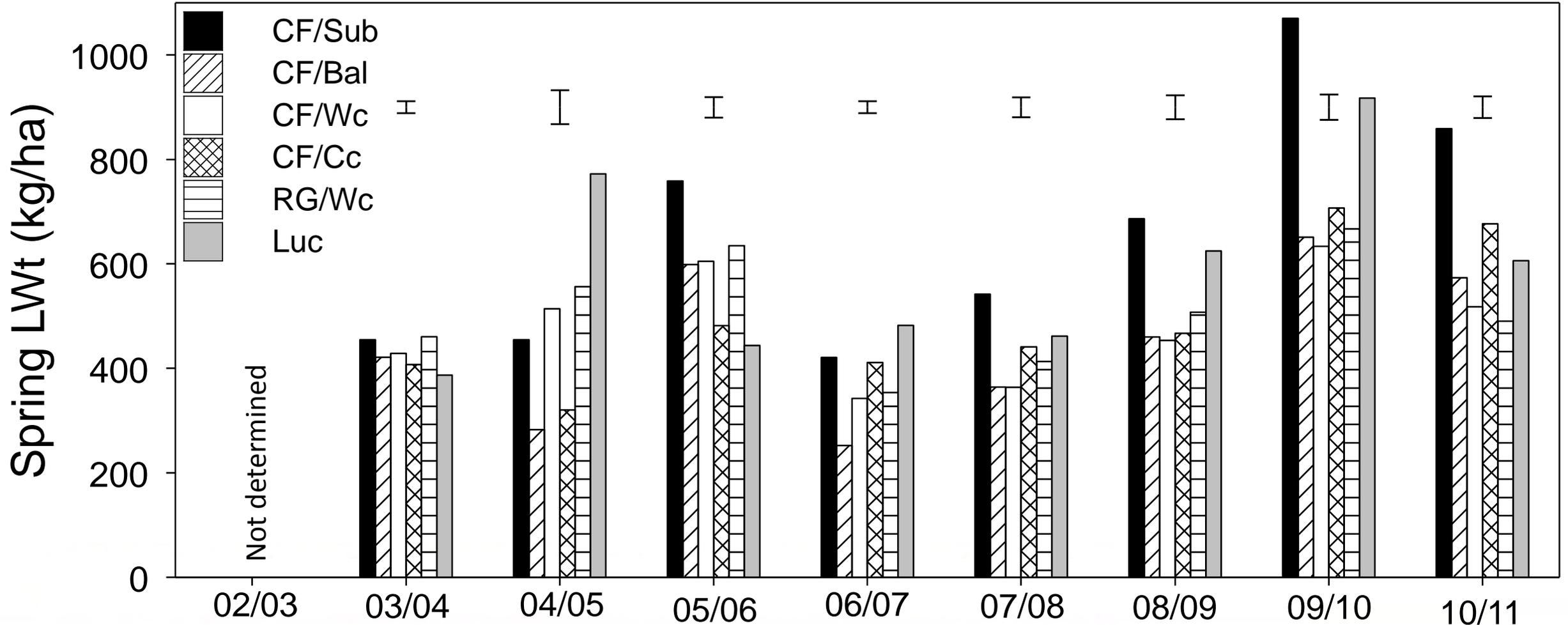
Pastures were generally destocked in winter when there was insufficient feed. This simulated a commercial farm system when sheep would be removed to graze winter forage crops or a smaller area of the farm set aside for winter grazing.

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.

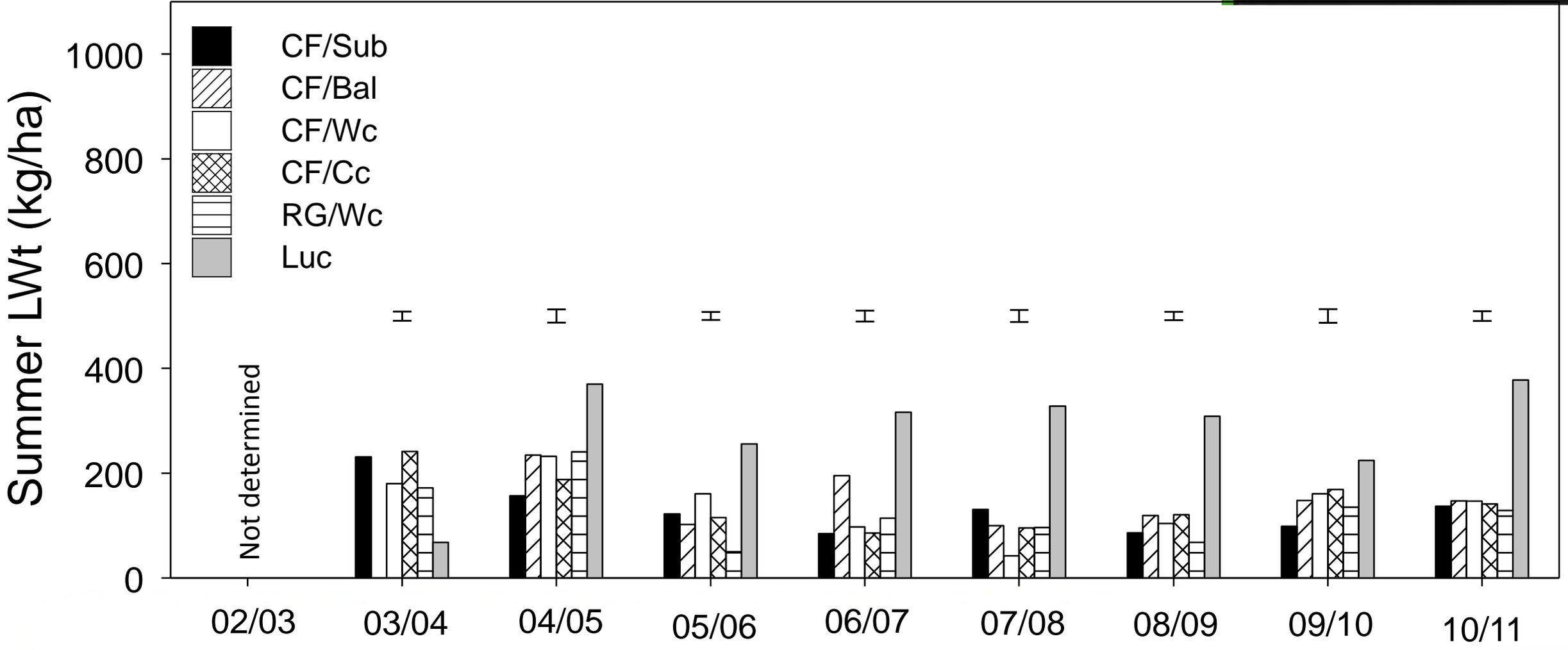
When necessary, ewes were used to hard graze annual clover pastures in early autumn to open the sward in preparation for the germination of annual clover seedlings after autumn rains.



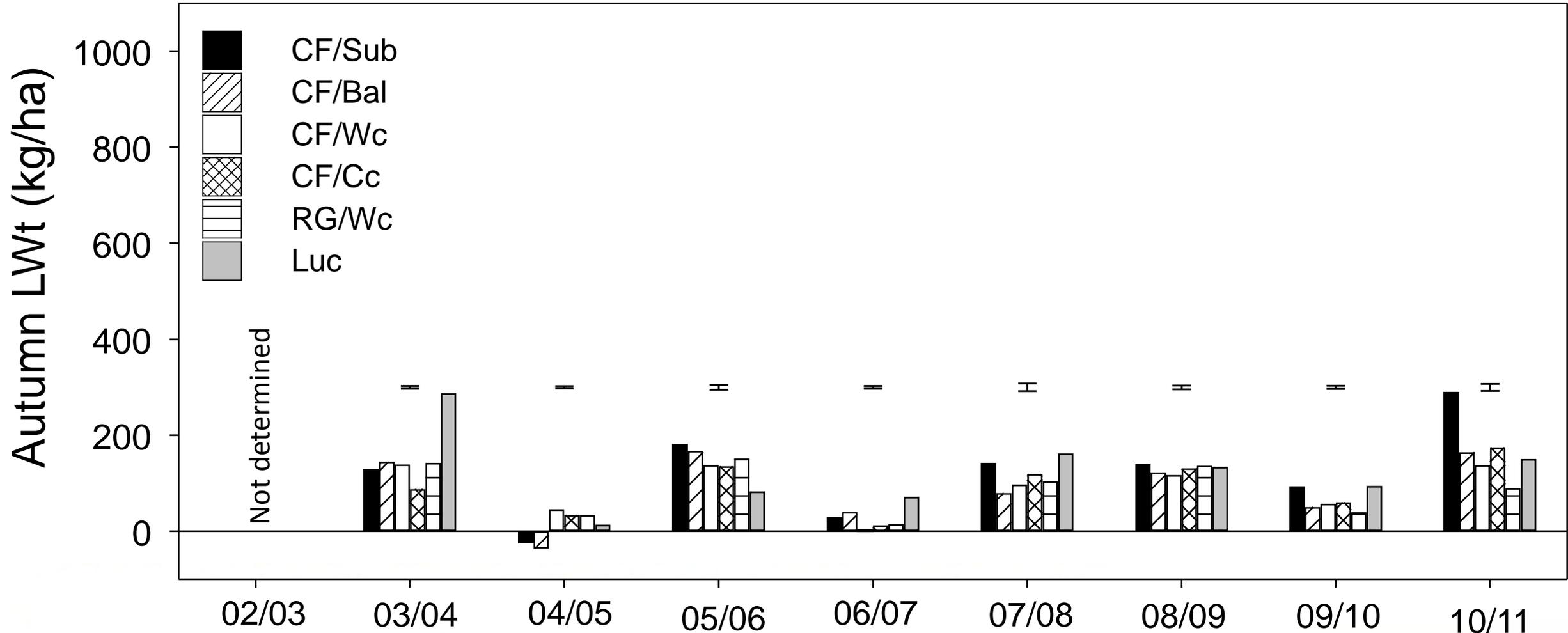
Total spring LWt production



Total summer LWt production



Total autumn LWt production



Yield and composition of six dryland pastures over nine growth seasons

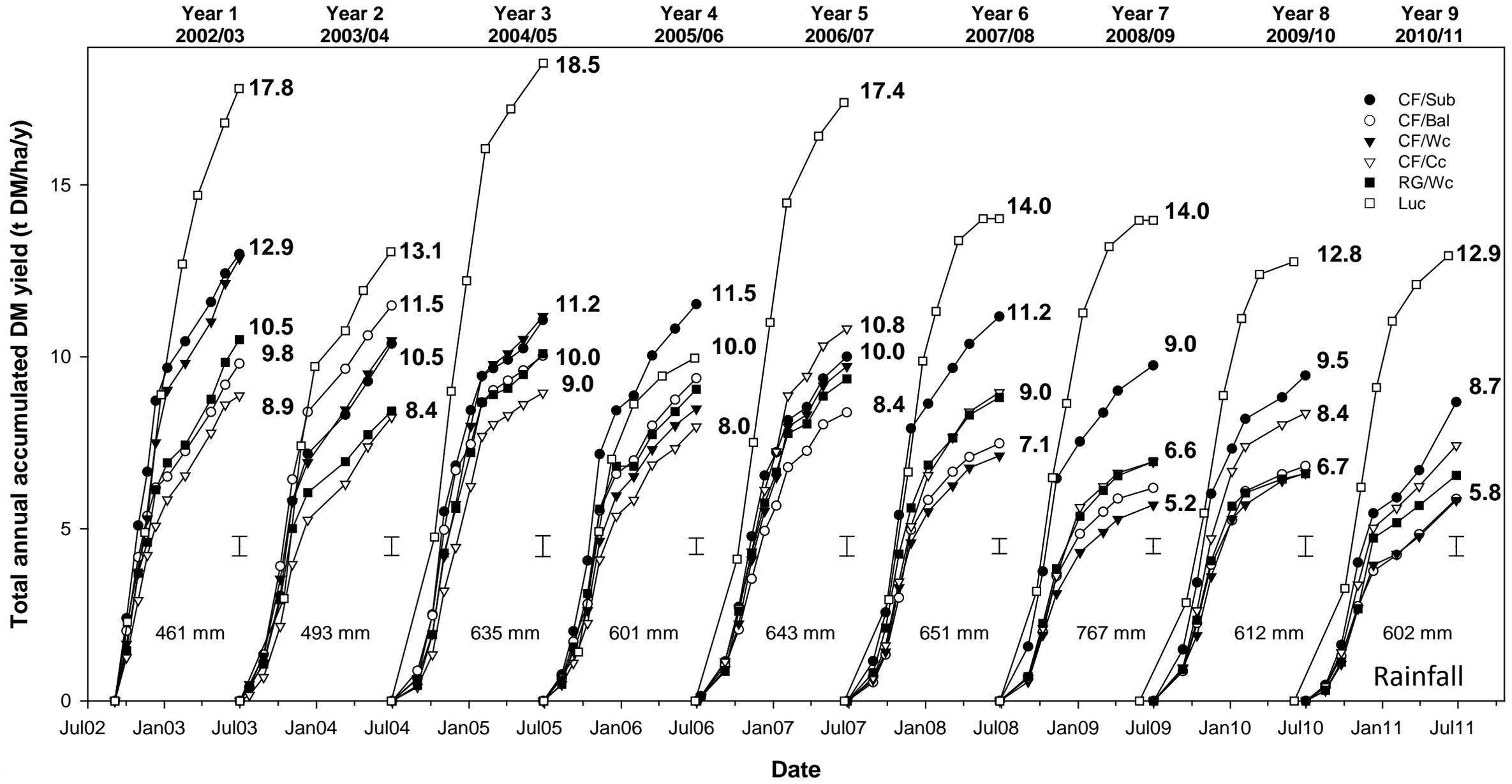


- Lucerne produced more DM than all grass based pastures in most years.
- Its tap-root enabled access to water from lower soil layers but it also used water more efficiently than the grass based pastures - especially in spring.
- CF/Sub clover was the highest yielding grass based pastures in Years 6-9.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

New Zealand's specialist land-based university



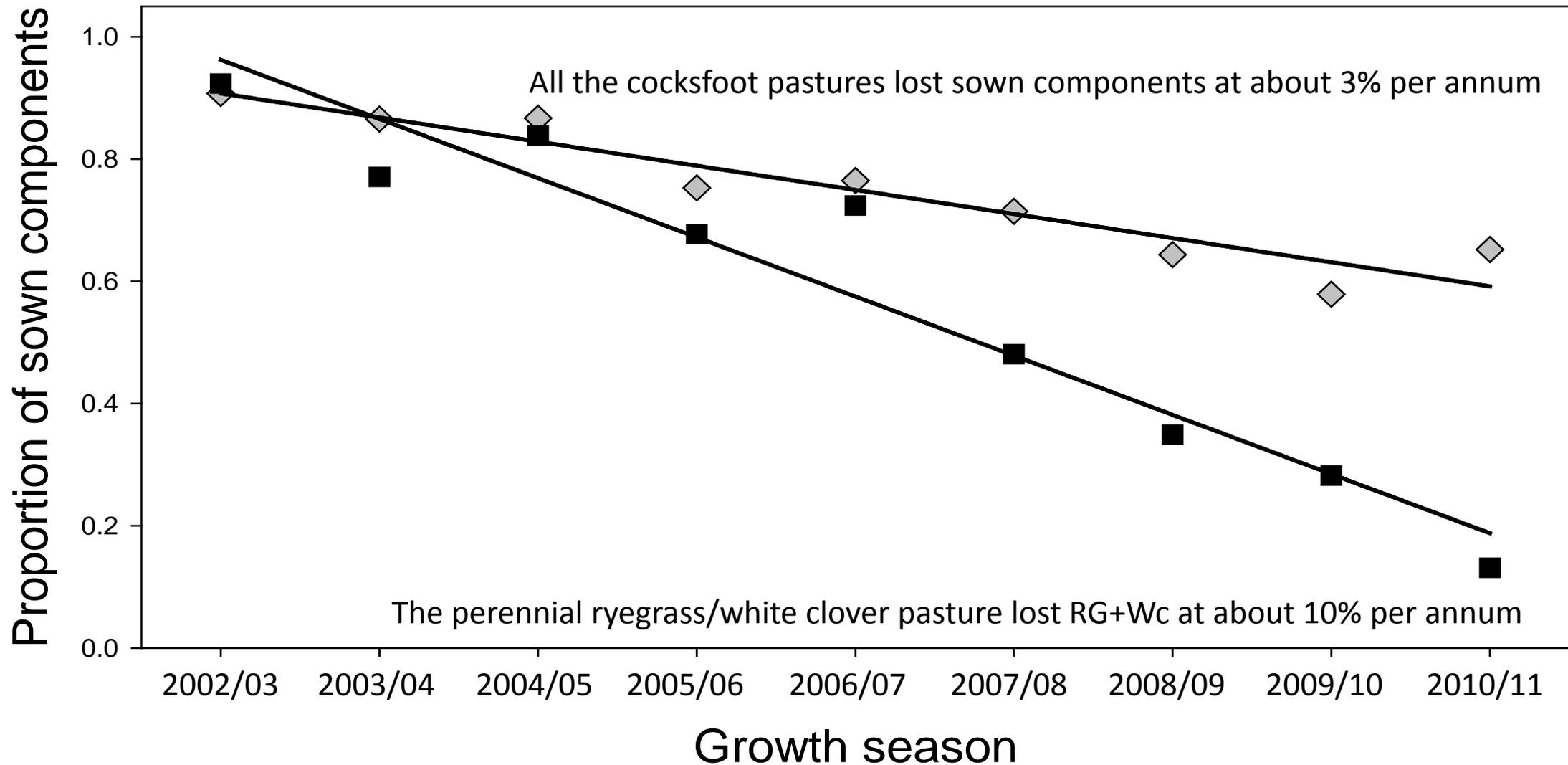
Figure 1. Total annual accumulated dry matter production



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



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.

Perennial ryegrass/white clover pastures



White clover in flower – Lees Valley, Canterbury.
Photo: Dr K.M. Pollock

- This section details the changes in yield and composition of the grazed perennial ryegrass/white clover pastures.
- Photos are included to show the condition of the pastures over time.

Perennial ryegrass/white clover pastures



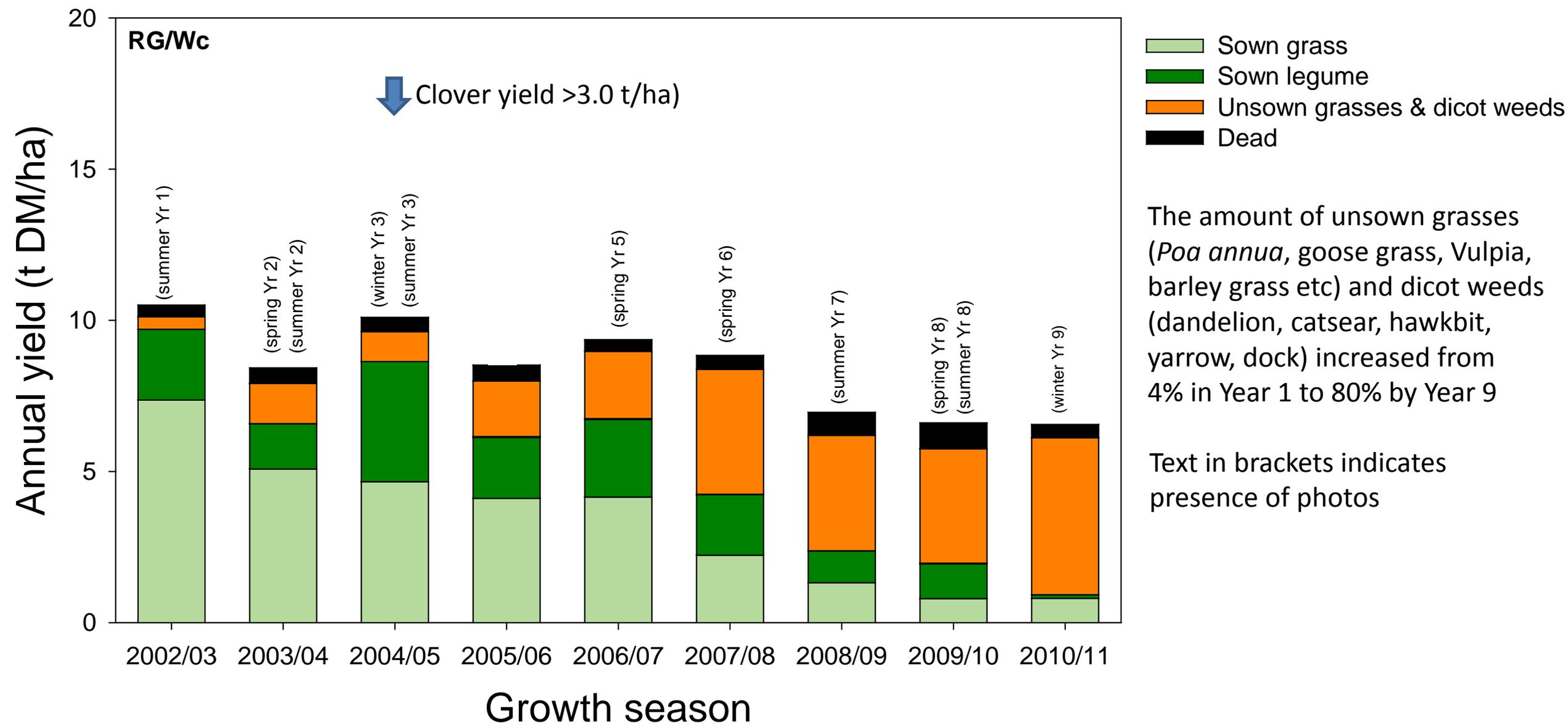
Introduction...

- Perennial ryegrass and white clover pastures have formed the basis of New Zealand's successful grass fed pastoral agriculture systems since white clover breeding began in the 1920's. There is substantial investment in breeding new white clover and perennial ryegrass cultivars relative to other permanent pasture species.
- It's ability to produce high yields of quality feed led to its recommendation as the primary pasture for pastoral areas throughout New Zealand.
- The mix is easily managed and performs well in suitable environments.
- However, it fails to thrive and persist in dryland drought prone areas.
- White clover loses its taproot at about 18 months after sowing and relies on a fibrous adventitious root system.

New Zealand's specialist land-based university



Figure 3. RG/Wc – Annual Botanical composition



Summary of Figure 3



- The combination of the timing and duration of periodic water stress and rooting depth of the pasture resulted in a recommended time to renewal of **5 years** for RG/Wc pastures based on the invasion of unsown species.
- In most cases experiments which measure pasture performance are only funded for a period of 3 years. However, farmers expect their perennial pastures to produce and persist for 10 years or longer to be cost effective. This long-term experiment shows that in periodically water stressed dryland environments recommendations based on 3 years of data (which show satisfactory yield and composition) would not meet farmer requirements for a productive and persistent pasture.
- The loss of both ryegrass and white clover meant there was no opportunity to salvage the pasture by overdrilling.

New Zealand's specialist land-based university

Yr 1 Summer
(Feb 2003)
RG/Wc

The pasture is about 1 year old and drill rows are still obvious.
The pasture was exposed to drought conditions with summer rainfall (80 mm) only about half of what would fall in an average year.



Dock

Yr 2 Spring
(Aug 2003)
RG/Wc



The RG/Wc pasture is about 18 months old in this photo and drill rows are less obvious but still visible. The pasture has recovered from summer drought conditions shown in the previous photo.

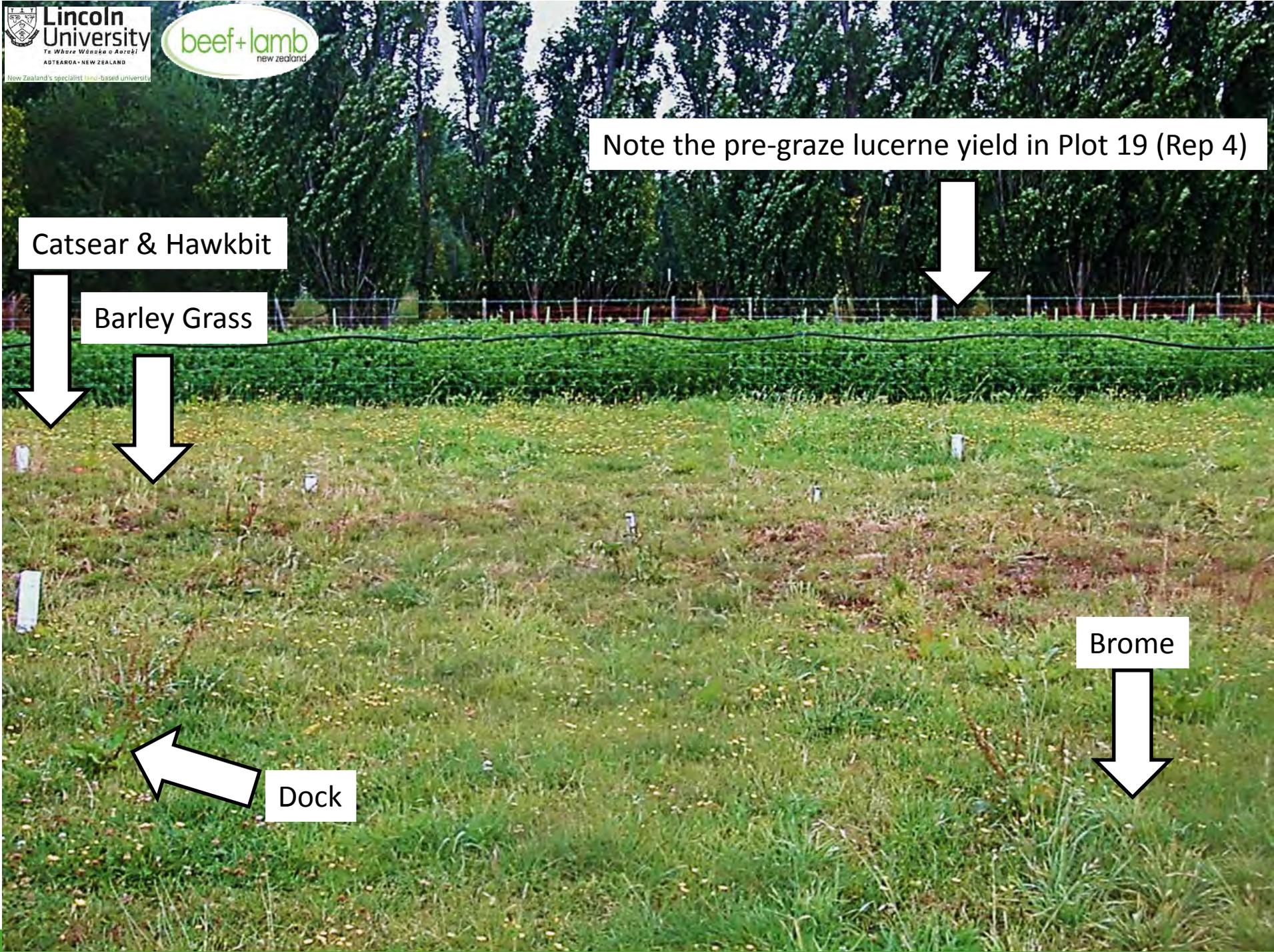


Yr 3 Summer (Feb 2005) RG/Wc

This shows a comparison of RG/Wc in Plot 13 in foreground with the pre-graze lucerne in Plot 19 Luc in background.

At this point perennial weed species have already started to invade the RG/Wc pasture even though annual rainfall was about average and summer rainfall almost 29% about average (180 mm).

The wet summer benefitted the white clover which has its main production period in the warmer summer months.



Note the pre-graze lucerne yield in Plot 19 (Rep 4)

Catsear & Hawkbit

Barley Grass

Brome

Dock

Yr 5 Spring
(Nov 2006)
RG/Wc

Two months later the perennial ryegrass has gone reproductive with seedheads visible or reproductive stems elongating.

The pasture is pale green and looks visibly N deficient with a build up of dead material in the base.



Yr 7 Summer (Jan 2009) RG/Wc

This was taken in Plot 21
about 1 month later than the
previous photo.

Summer rainfall was about
30% above average and green
material is visible beneath the
dead reproductive stems.

Few of these appear to be
from perennial ryegrass.
Yellow flowers of the
perennial flatweed catsear
(arrows) can be seen
throughout the pasture.



Yr 8 Spring
(Sept 2009)
RG/Wc

By spring of Year 8 the perennial rhizomatous weed yarrow is present.

This is now problematic for pasture renewal because, if cultivated, chunks of the yarrow root can form individual new plants and contaminate newly sown crops or pastures.

In this case the extent of the invasion and the type of weeds present mean the renewal phase may need to be extended to ensure adequate weed control before a new pasture can be established.

Ryegrass is not visible.



Yr 8 Summer (Dec 2009) RG/Wc

Summer rainfall was about 30% below average and the sheep grazing in the background continue to avoid the less palatable dying seedheads of the invading grasses.

There is no evidence of perennial ryegrass seedheads in this image.

Much of the green material is goose grass, *Vulpia* and *Poa annua*.



Yr 9 Winter (Jun 2011) RG/Wc

This is what a RG/Wc clover pasture looks like at the end of nine years in a grazed experiment in a periodically water stressed environment.

There is no evidence of any perennial ryegrass and few white clover leaves.

The majority of the unsown grasses will remain palatable to grazing stock – until they become reproductive or die.

However, stock grazing these pastures (or wind dispersal) could hasten the deterioration of other pastures on a farm by transferring the seeds of these species into other pastures on farm during the course of a rotation.



Cocksfoot/Subterranean clover pastures

This section describes the production and persistence of the CF/Sub pastures from Year 1 (2002/03) to Year 9 (2010/11) through a combination of measured data and photos.

Sub clover...

An annual clover, sub germinates from seed in autumn before growing slowly through winter. Its main production period is Sept-Oct before it flowers, sets seed then buries it and dies. This mechanism is known as **drought avoidance**. The plant survives by avoiding the drought period and regenerating from buried seed in open areas of the pasture following autumn rains.

When the plant dies **nitrogen** is released into the soil as the plant material breaks down and this becomes available to the cocksfoot. Nitrogen is also directly transferred to the other pasture components in urine returns from grazing stock. Sub clover fixes about 25 kg N per ton of clover DM produced – the higher the clover yield the more N enters the system to alleviate N deficiency symptoms in the grass.

To maintain sub clover in the pasture an early close up at 3-4 year intervals will allow the maximum amount of seed to set and replenish the seed bank.



'Antas' sub clover leaf – Mt Bengier, North Canterbury
Photo: RJ Lucas

Cocksfoot/Subterranean clover pastures



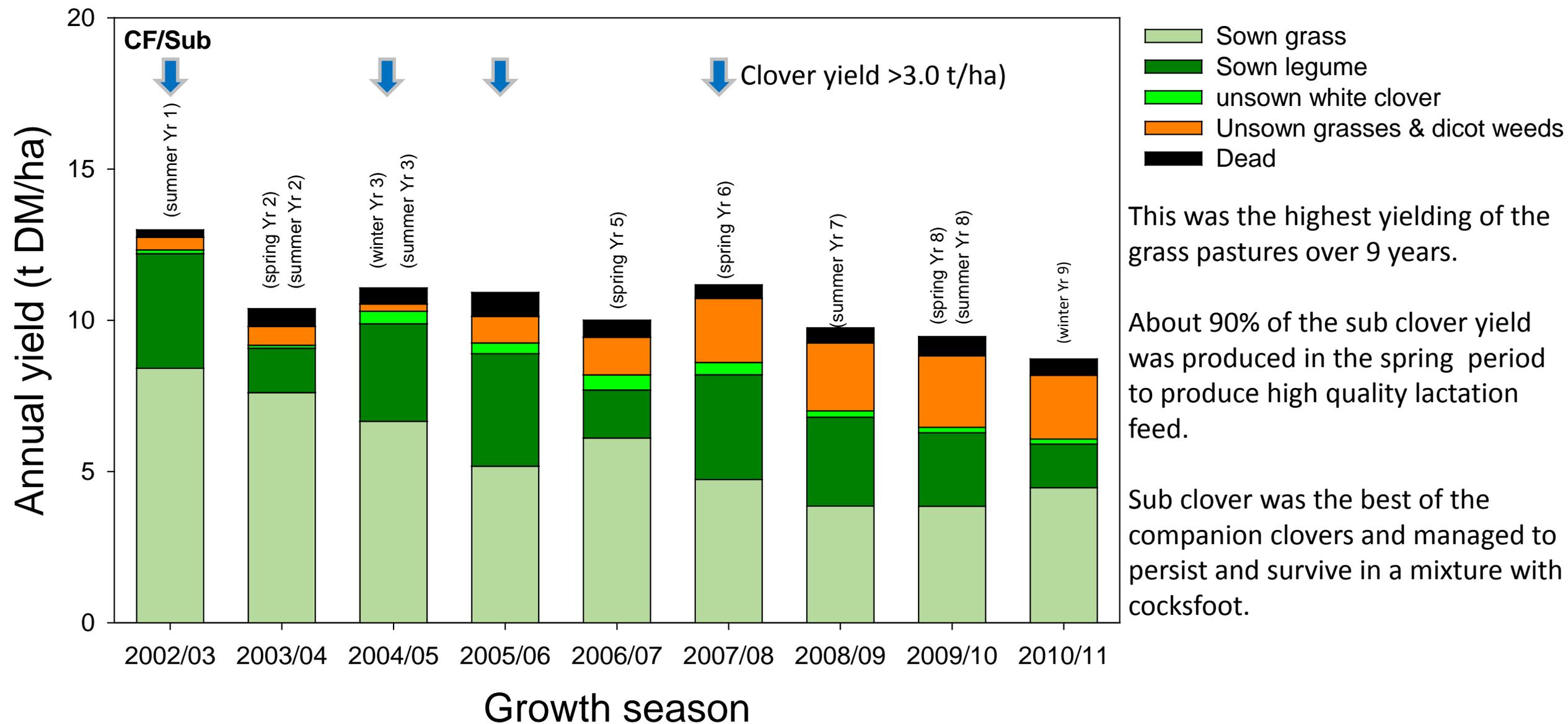
Total yields ranged from 13.0 t/ha (Year 1) to 8.7 t/ha (Year 9).

By Year 9, 67% of the total yield was from the originally sown species.

In four of the nine years the sub clover yield was >3.0 t/ha (blue arrows).

New Zealand's specialist land-based university

Figure 4. CF/Sub – Annual Botanical composition



Summary of Figure 4



- The CF/Sub pasture was the most productive and persistent of the grass-based pastures monitored over nine years.
- As with all pastures the total yield declined over time. However, the persistence of the cocksfoot and sub clover meant there was no need to renew the pastures at the end of the experiment.
- These pastures could be overdrilled with 10 kg/ha sub clover plus 1 kg/ha white clover into a hard grazed pasture in autumn. This would stimulate total pasture production by increasing clover content and subsequent N transfer to the cocksfoot component. We recommend 5 kg/ha each of a mid and late flowering sub clover in this environment to allow for year-to-year variation in rainfall. White clover can contribute when summer rainfall allows.
- Previous research by Ates *et al.* (2010) at Ashley Dene has shown overdrilling into grass dominant dryland pastures with sub clover can increase DM production by 40% annually and costs are reduced because full renovation is not necessary. (http://www.grassland.org.nz/publications/nzgrassland_publication_14.pdf)

Yr 2 Summer (Jan 2004) CF/Sub

In the driest summer, a bit of cocksfoot remains green in the CF/Sub pasture compared with the RG/Wc pasture where only a bit of white clover remained green at this time of year.
The quadrat is 0.1 m².



Yr 3 Winter (Jul 2004) CF/Sub

Note the presence of young sub clover plants in winter (following the 2nd natural reseeding – seed produced in the first year has softened enough to germinate following autumn rains).

Sub clover has expanded from the drill rows and has begun to exploit the areas between drill rows.

Total sub clover yield from these plants was >3.2 t DM/ha in Year 3.



Yr 6 Spring
(Nov 2007)
CF/Sub

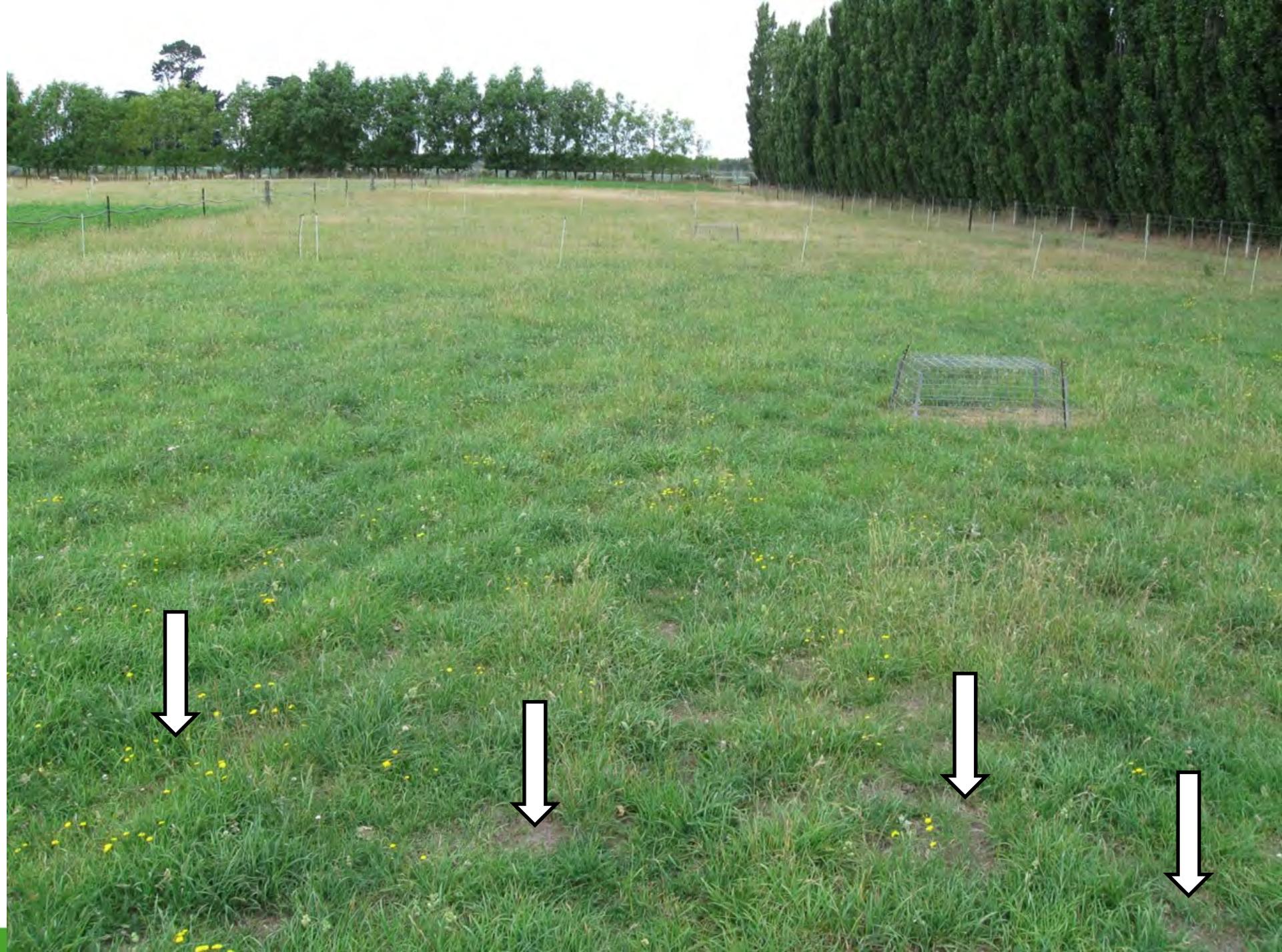
A close up of
the pasture in
the previous
photo.



Yr 7 Summer
(Jan 2009)
CF/Sub

CF/Sub pasture in Plot 24
(Rep 4).

Note the presence of bare ground following the end of the sub clover life cycle and the invasion of dicot flatweeds in the foreground (arrows).



Yr 8 Spring (Sept 2009) CF/Sub

CF/Sub pasture in Plot 5.

In Yr 8 the 2.4 t/ha of yield contributed by sub clover was more than double the clover yield produced from any other grass based pasture.

For the spring period (to 16 Nov 2009) about 40% of the DM yield on offer was sub clover.



Yr 8 Summer (Dec 2009) CF/Sub

Bare ground is visible following the end of the sub clover lifecycle.

A few barley grass seedheads are visible but it remains a minor component of the pasture compared with the level of invasion observed in the RG/Wc pastures of the same age.

It is important to **hard graze prior to autumn rainfall** to open these bare ground patches for small germinating clover seedlings. Rank, leafy grass pastures will shade out small establishing clover plants and they will not survive.



Yr 9 Winter (Jun 2011) CF/Sub

This is a CF/Sub clover pasture nine years after establishment.

Cocksfoot remains a major component of the pasture and sub clover can be seen in the base of the sward.

In six of the nine years sub clover contributed 26-32% of all DM produced on an annual basis.

Overdrilling with sub clover in autumn will rejuvenate the pastures and increase total annual production.



Lucerne monocultures



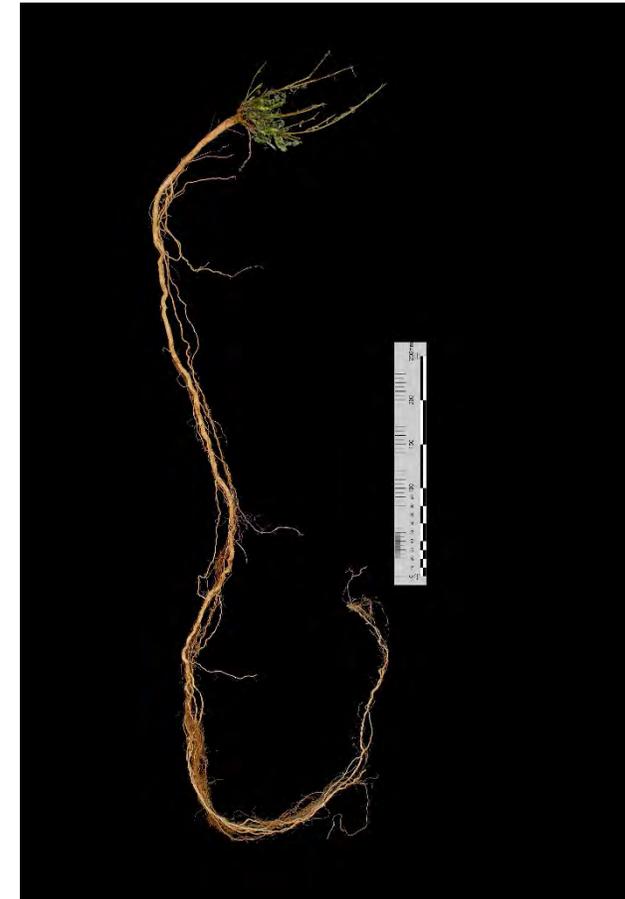
Yield data and photos are used to document the performance of the lucerne monocultures in this section.

Lucerne...

Lucerne is a taprooted, summer active, perennial legume. Its benefit in summer dry regions comes from its deep taproot which allows it to extract water from lower in the soil than grass based pasture species. This allows growth to continue for longer as drought conditions develop.

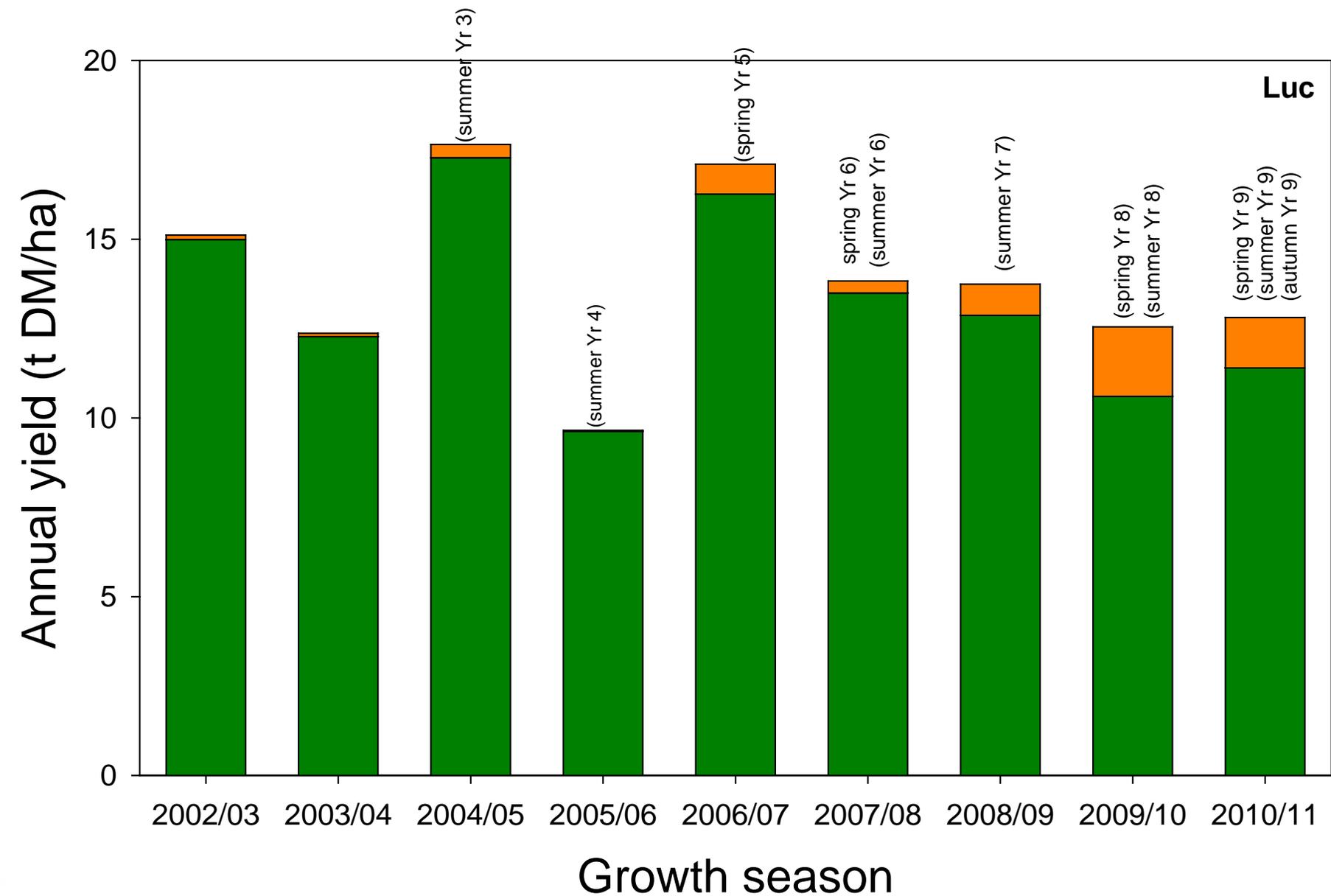
Spring growth is more than expected because carbohydrates stored in the roots are remobilised to boost above ground yields. However, to maintain a productive and persistent stand lucerne must be allowed to flower once after the longest day. It is this environmental trigger which changes the partitioning priority of the plant and carbohydrates are preferentially directed back in the roots to replenish the reserves. Failure to replenish the reserves means there are less reserves for growth in the following spring. A lucerne stand can be destroyed within two years if not managed correctly.

Lucerne was rotationally grazed throughout active growth over nine years and weed control applied in winter when required. Spring grazing was initiated when lucerne in the first paddock reached 20 cm in height.



Lucerne plant with roots – 18 months after sowing
Photo: D. Hollander

Luc – Annual Botanical composition



Luc

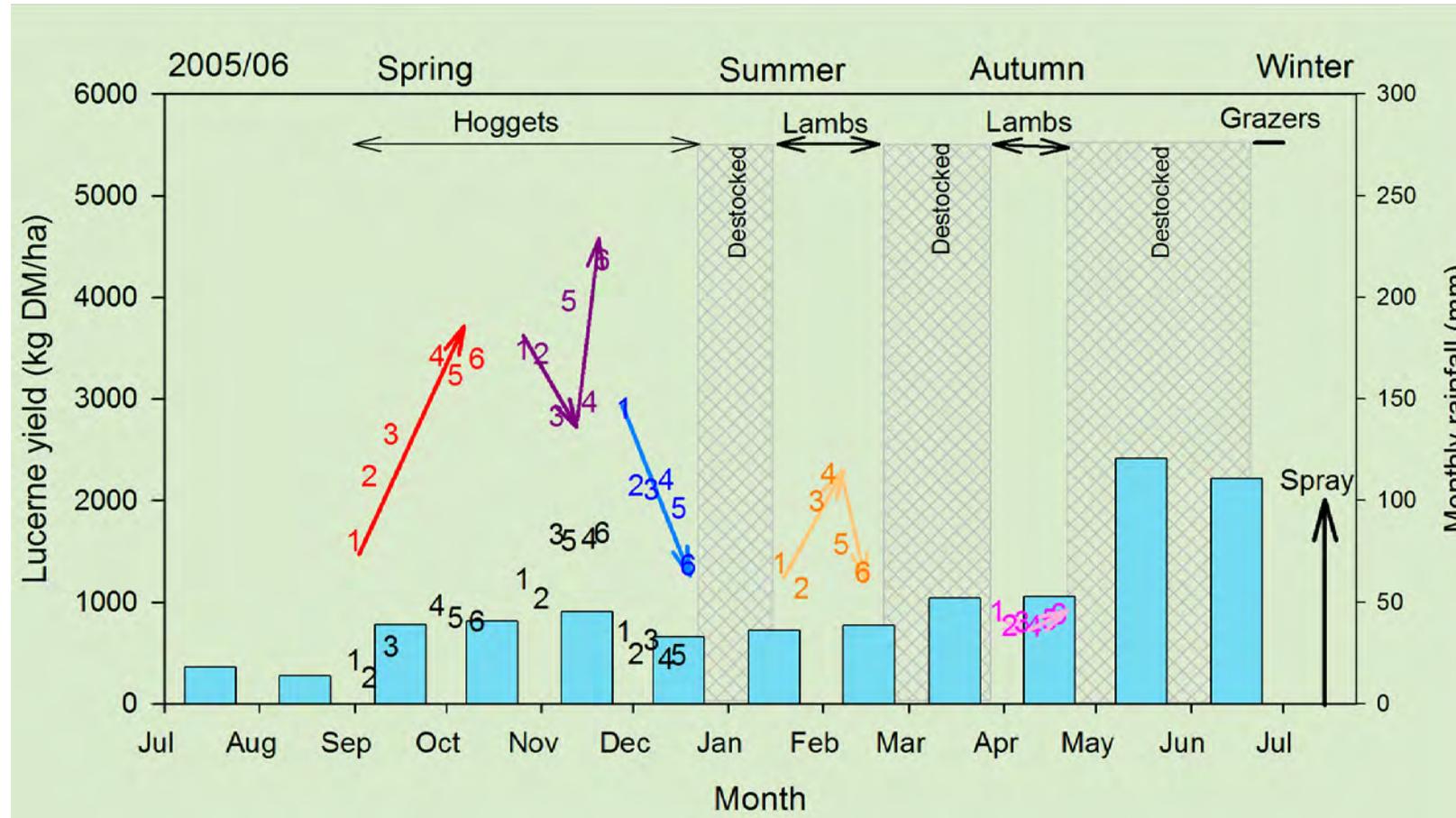
- Sown legume
- Unsown grasses & dicot weeds
- Dead

Lucerne monocultures produced more feed than the grass pastures in most years.

The benefit was mainly seen in summer when lucerne growth continued because it could access soil water from deeper in the soil. Annually, lucerne had higher animal LWt gains per head and per hectare in most years.

Lucerne was treated as a monoculture and winter herbicides were applied to control invading weeds when necessary.

Rotational grazing of lucerne



This shows the pre-grazing yields in the six paddocks (1-6) throughout five grazing rotations in 2005/06 (Year 4).

In the first rotation (red) the yield in paddock 1 was about 1.5 t/ha when grazing started. Growth continued in paddocks 2-6 and increased ahead of the grazing mob to reach about 3.3 t/ha prior to the start of grazing in paddocks 4-6.

In the second rotation (purple) paddocks 3 and 4 had lower production as water stress developed but rainfall allowed paddocks 5 and 6 to recover.

Rotation 3 (blue) was compromised by water stress. In summer a change in partitioning meant above ground yield was reduced as the plant replenished root reserves.

Yields were lowest in Rotation 5 (pink) due to the seasonal decline in temperature.

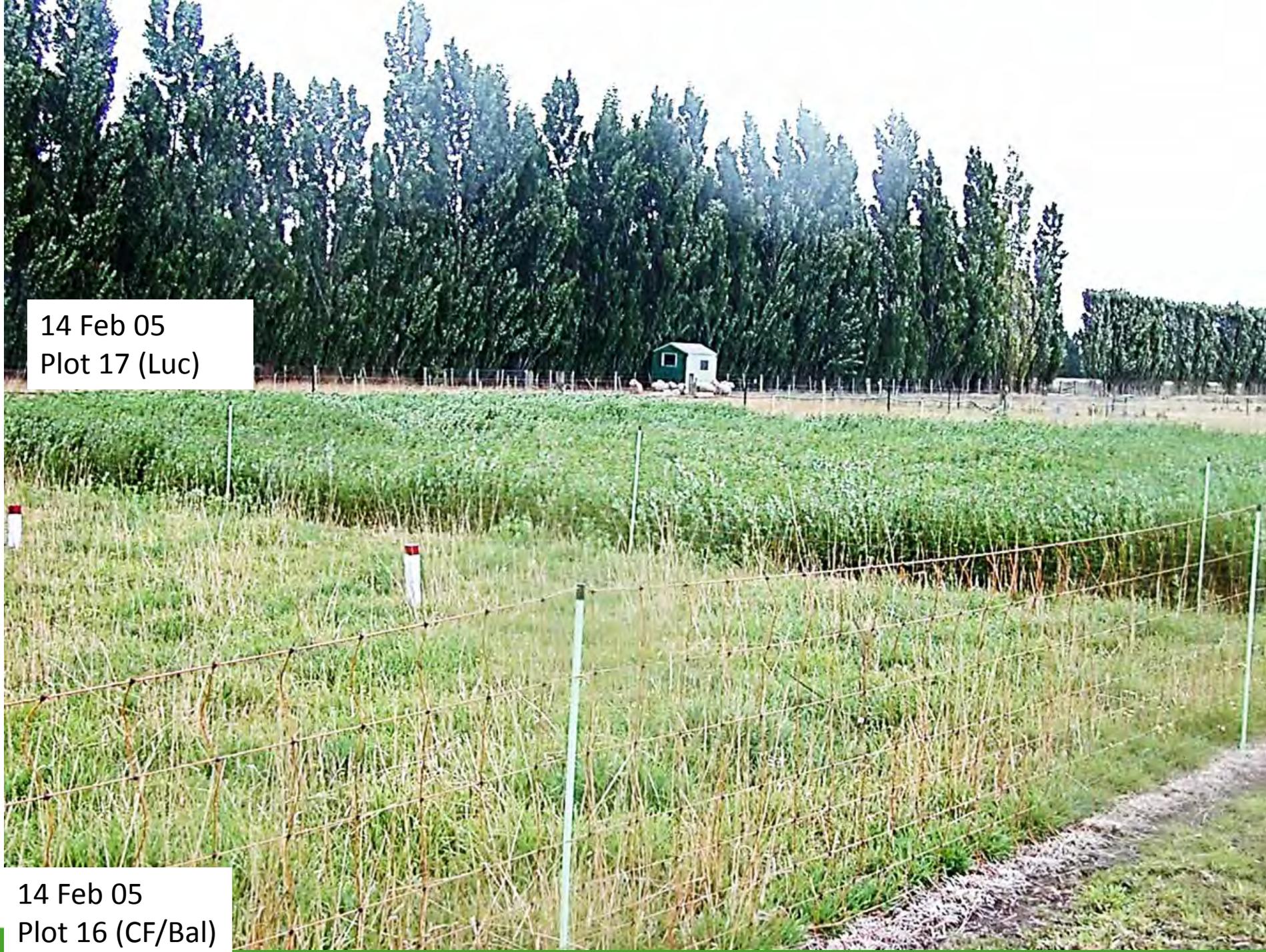
(Numbers in black are the post-grazing residuals.)

Yr 3 Summer (Feb 2005) Luc

In Year 3, (2004/05), lucerne yielded 18.5 t DM/ha.

This was 65% more than the 11.2 t/ha produced by the CF/Wc pasture and more than double the 9.0 t/ha produced from the CF/Cc pasture.

Summer rainfall totalled 184 mm which was 28% above average.



14 Feb 05
Plot 17 (Luc)

14 Feb 05
Plot 16 (CF/Bal)

Yr 5 Spring
(Sept 2006)
Luc

In Year 5 total annual lucerne yield was 17.3 t DM/ha compared with grass pastures which yielded 8.4 (CF/Bal) to 10.4 t DM/ha (CF/Sub and CF/Cc pastures).



Yr 7 Summer (Jan 2007) Luc

Also Jan 2007 but later in than the previous photo. This shows Plot 19 (Rep 4) in the foreground during grazing in late Jan 2007 is in the foreground.

Note the destocked, reproductive, drought stressed grass based pastures beyond the lucerne.



Yr 8 Spring (Sept 2009) Luc



First spring grazing with ewes and twin lambs at foot.

Lucerne yield was 12.8 t DM/ha compared with the 6.7 (CF/Wc) to 9.5 t DM/ha (CF/Sub) produced by the grass based pastures.

Rainfall for the Jul-Nov period was 195 mm and almost 30% below average. Summer rainfall was also below average in Year 8.

Yr 8 Summer (Dec 2009) Luc

The lucerne sward has opened up as individual lucerne plants have died over time.

The main perennial weeds invading the lucerne were dandelion and hawkbit and the annual shepherds purse.

Some grass weeds have also established in the lucerne.



Yr 9 Autumn (Mar 2011) Luc

Lucerne in Plot 25 (Rep 5) in full flower to recharge root system. This feed would not be recommended for flushing or mating livestock due to the increase in coumestrol content in reproductive lucerne.

However, non breeding stock will still benefit from eating lucerne which is likely to be of higher quality than other drought stress pastures available on a dryland property at this time.

For this lucerne stand we would now recommend overdrilling with brome or cocksfoot to create a runout mix suitable for grazing with ewes and lambs in early spring.



Conclusions from MaxClover after nine years

- Animal LWG was associated with more dry matter production in spring.
- 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.

MaxClover Publications (to June 2014)



Journal & Conference papers

- Brown, H. E., Moot, D. J., Lucas, R. J. and Smith, M. 2006. [Sub clover, cocksfoot and lucerne combine to improve dryland stock production](#). *Proceedings of the New Zealand Grassland Association*, **68**, 109-115.
- 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., Lucas, R. J. and Moot, D. J. 2014. 'MaxClover' Grazing Experiment: 1. 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. 2014. 'MaxClover' Grazing Experiment: 2. Annual and seasonal sheep liveweight production from six grazed dryland pastures over eight growth seasons. *New Zealand Journal of Agricultural Science*, *Submitted for review*.
- Mills, A. and Moot, D. J. 2010. [Annual dry matter, metabolisable energy and nitrogen yields of six dryland pastures six and seven years after establishment](#). *Proceedings of the New Zealand Grassland Association*, **72**, 177-184.
- Mills, A. and Moot, D. J. 2010. [Nitrogen yields from sown pasture components in cocksfoot based pastures in a temperate environment](#). In: XIth Conference of the European Agronomy Society, August 29 to September 03, 2010, Montpellier, France. p 707-708.
- Mills, A., Smith, M. C., Lucas, R. J. and Moot, D. J. 2008. [Dryland pasture yields and botanical composition over five years under sheep grazing in Canterbury](#). *Proceedings of the New Zealand Grassland Association*, **70**, 37-44.
- Mills, A., Smith, M. C. and Moot, D. J. 2008. [Liveweight production from dryland lucerne, cocksfoot or ryegrass based pastures](#). In: Global Issues, Paddock Action. Proceedings of the 14th ASA Conference, 21-25 September 2008, Adelaide, South Australia.
- Monks, D. P., Moot, D. J., Smith, M. C. and Lucas, R. J. 2008. [Grazing management for regeneration of balansa clover in a cocksfoot pasture](#). *Proceedings of the New Zealand Grassland Association*, **70**, 233-238.
- Moot, D. J. 2012. [An overview of dryland legume research in New Zealand](#). *Crop and Pasture Science*, **63**, 726-733.
- 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>.
- Teixeira, E. I., Moot, D. J. and Mickelbart, M. V. 2007. [Seasonal patterns of root C and N reserves of lucerne crops \(*Medicago sativa* L.\) grown in a temperate climate were affected by defoliation regime](#). *European Journal of Agronomy*, **26**, 10-20.
- Tonmukaykul, N., Moot, D. J. and Mills, A. 2009. [Spring water use efficiency of six dryland pastures in Canterbury](#). *Proceedings of the Agronomy Society of New Zealand*, **39**, 81-94.

New Zealand's specialist land-based university

MaxClover Publications (cont.)

(to June 2014)



Thesis/Dissertations

- Ates, S. 2009. [*Productivity, botanical composition and insect population of seven dryland pasture species in Canterbury after eight years*](#). PhD thesis, Lincoln University, Canterbury. 189 pp.
- Buckley, C. 2002. [*Sociability of four clover species during pasture establishment*](#). B.Ag.Sci (Hons) dissertation, Lincoln University, Canterbury. 103 pp.
- Monks, D.P. 2009. [*The vegetative and reproductive development of balansa clover*](#). PhD thesis, Lincoln University, Canterbury. 164 pp.
- Morris, N.J. 2010. [*Productivity, botanical composition and insect population of seven dryland pasture species in Canterbury after eight years*](#). M.Ag.Sci thesis, Lincoln University, Canterbury. 93 pp.
- Sangster-Ward, J. 2003. The timing of autumn rain affects cool season performance of clover species grown with cocksfoot. B.Sci. dissertation, Lincoln University, Canterbury, 90 pp.
- Tonmukayakul, N. [*Water use efficiency of six dryland pastures in Canterbury*](#). M.Ag.Sci. Thesis, Lincoln University, Canterbury. 73 pp.

New Zealand's specialist land-based university



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



Invermay, Otago
4th September 2014

Pasture (legume) establishment

Dr Derrick Moot
Professor of Plant Science

New Zealand's specialist land-based university

Water and nitrogen = ryegrass

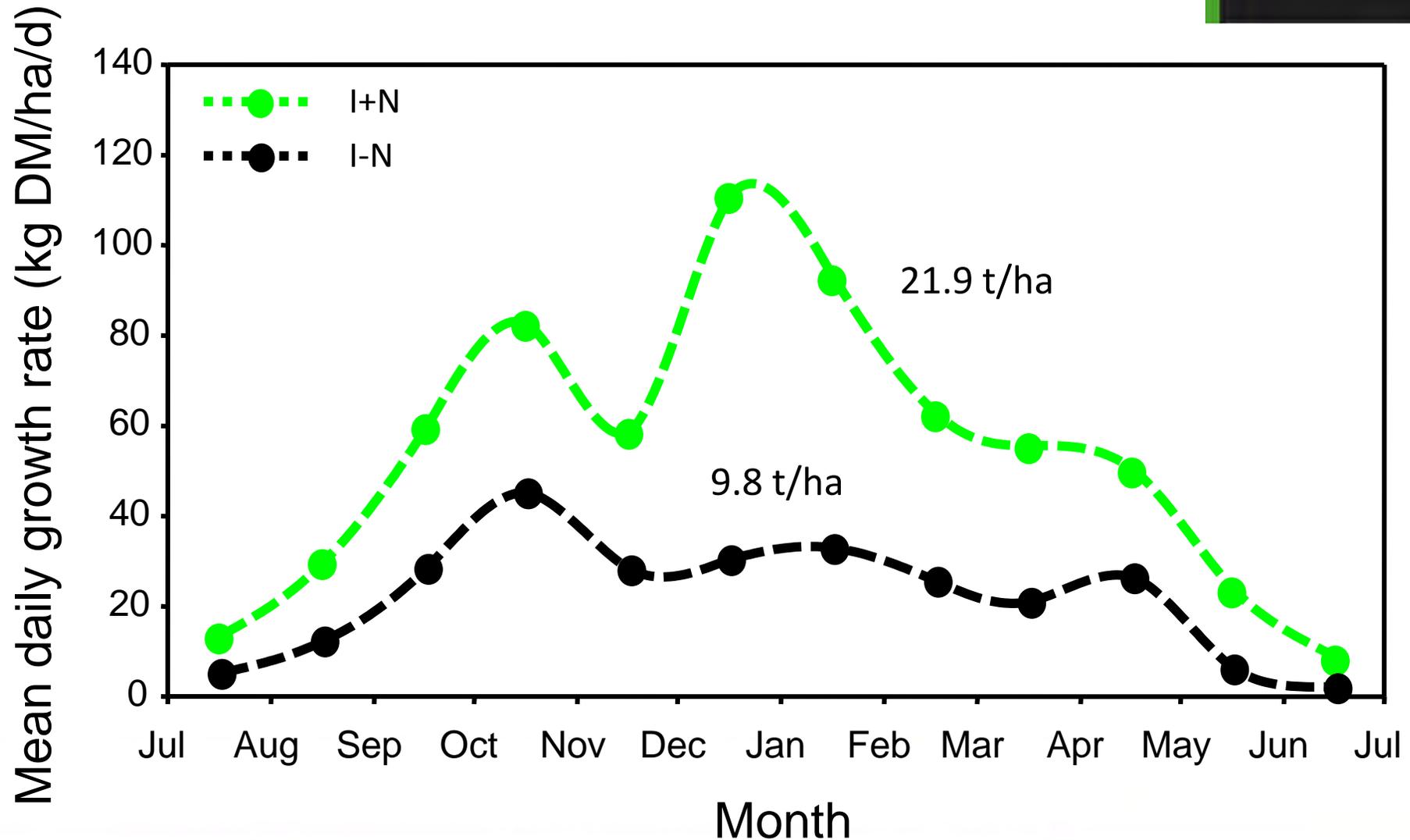


Nitrogen deficient pasture

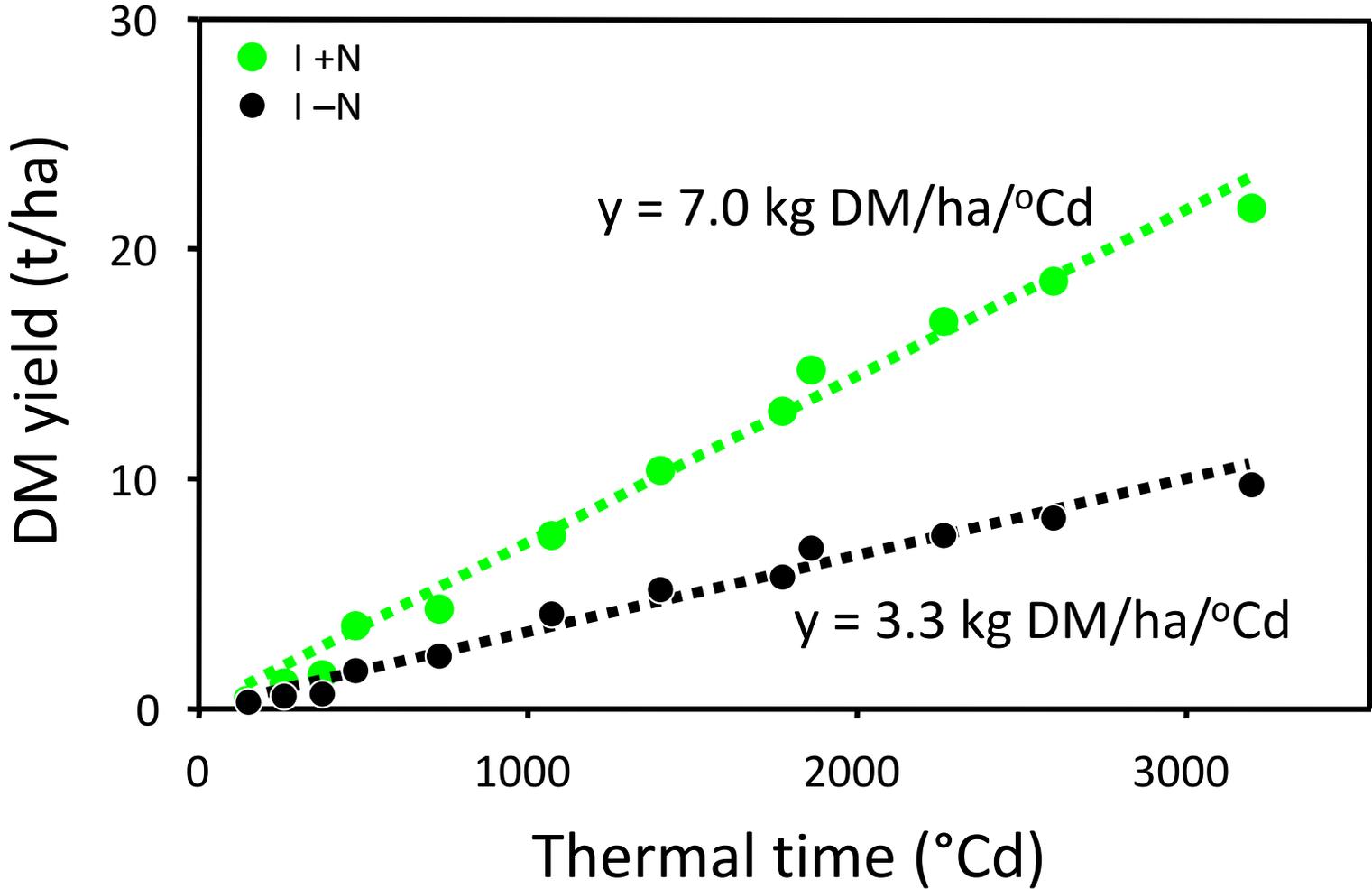


1000 kg N/ha

Pasture Growth Rates – 2 yr mean



The Nitrogen gap



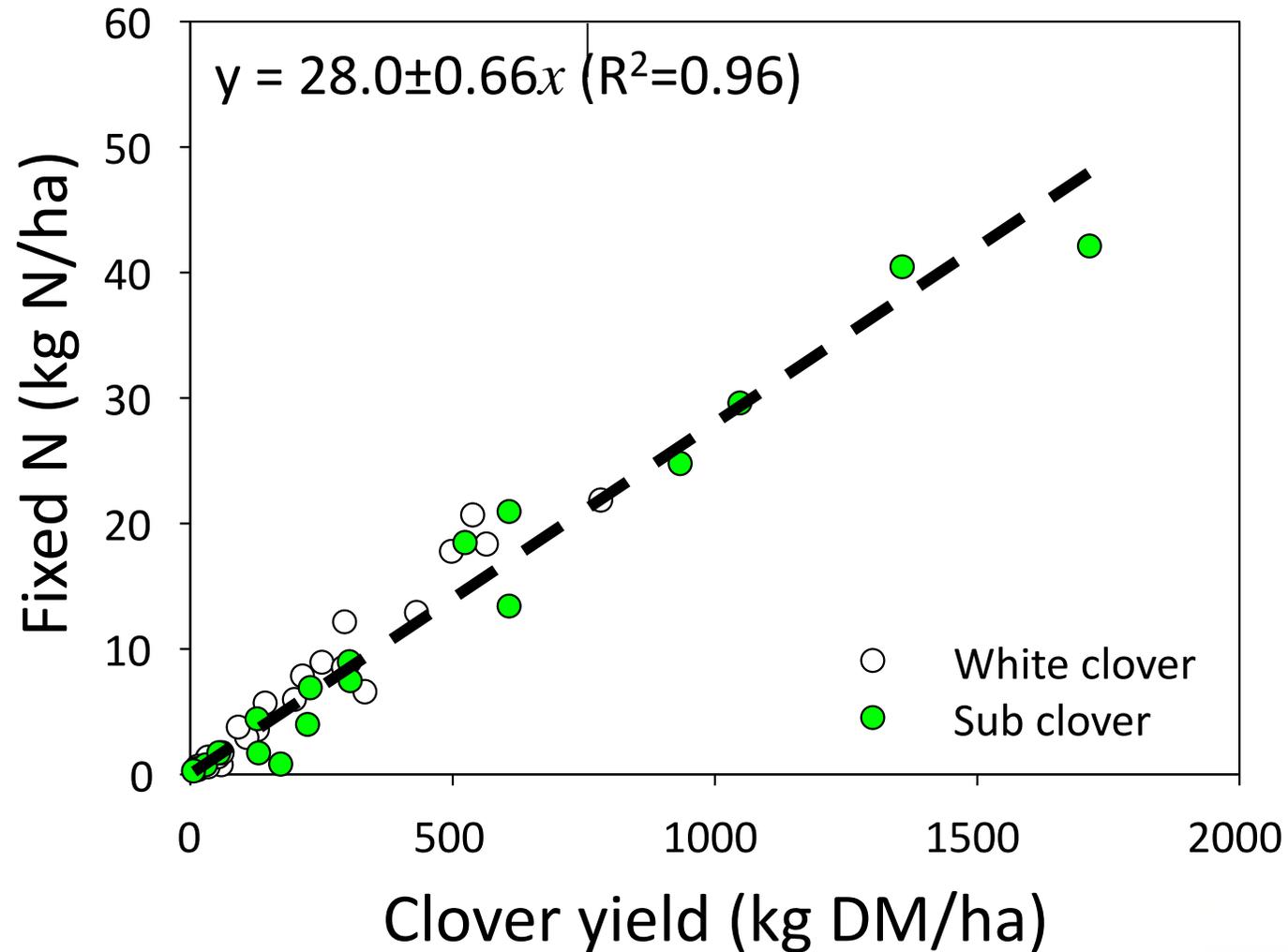
21.9 t/ha

9.8 t/ha

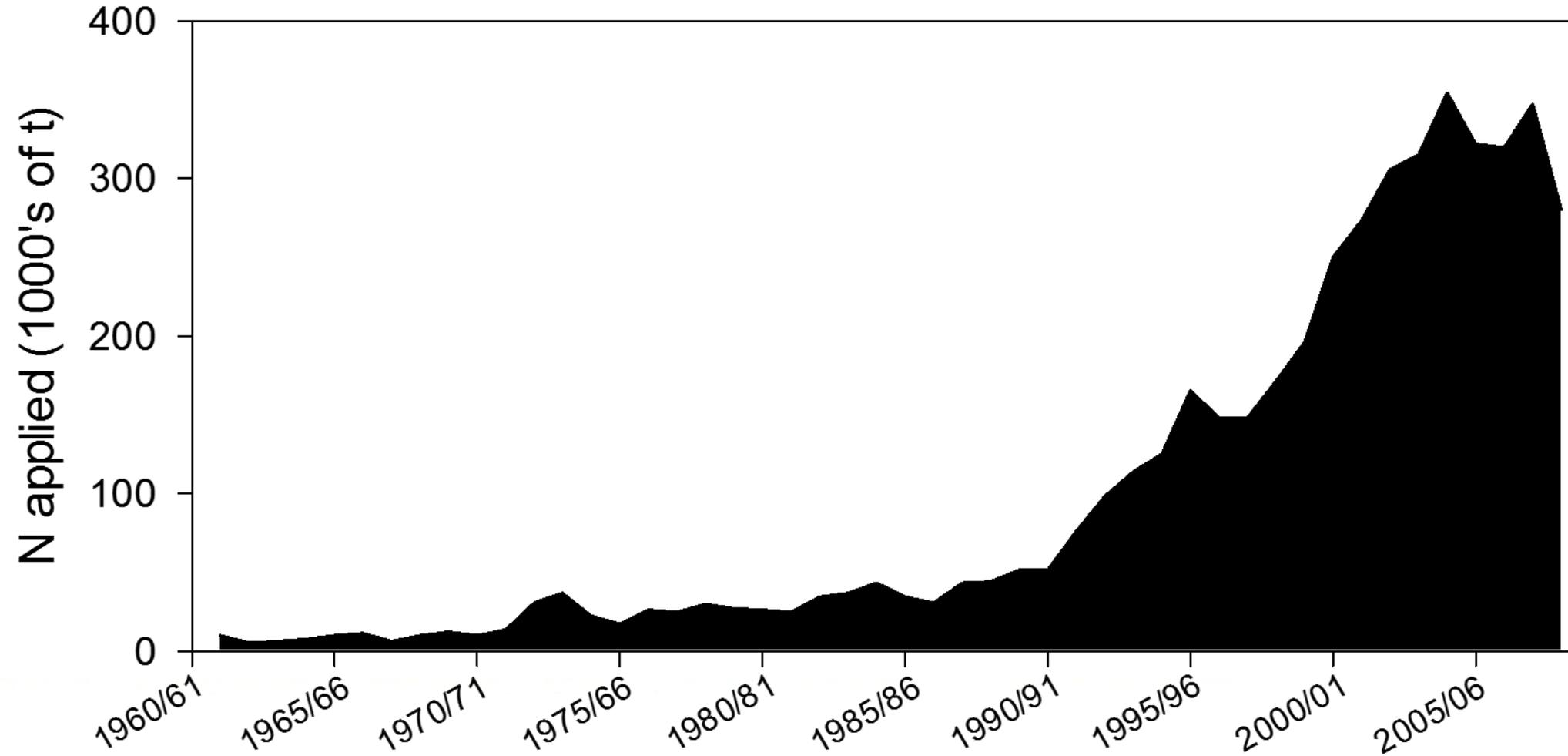


**Nitrogen fixation
25 kg N/t DM**

Biological N fixation



Nitrogen fertiliser use





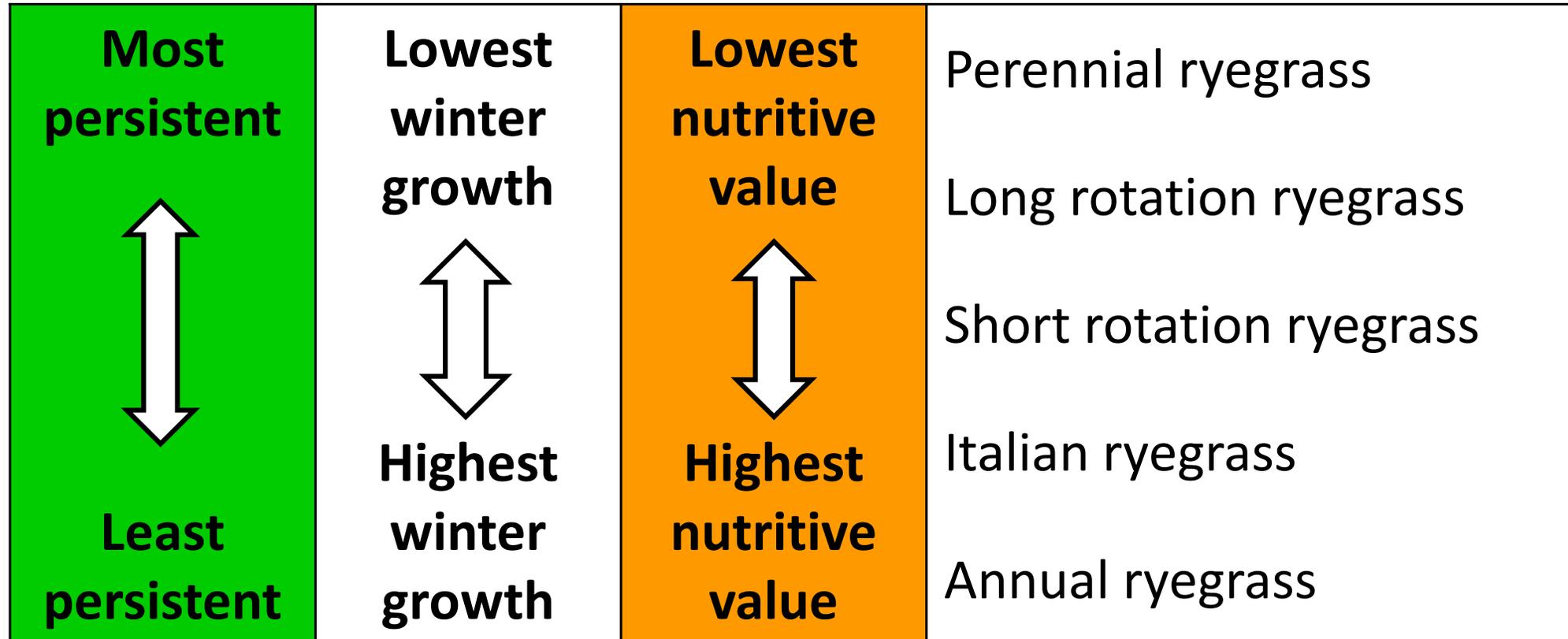
Lincoln
University
Te Whare Wānaka o Aoraki
AOTEAROA • NEW ZEALAND



Growing point

Photo: A Black

The ryegrass continuum



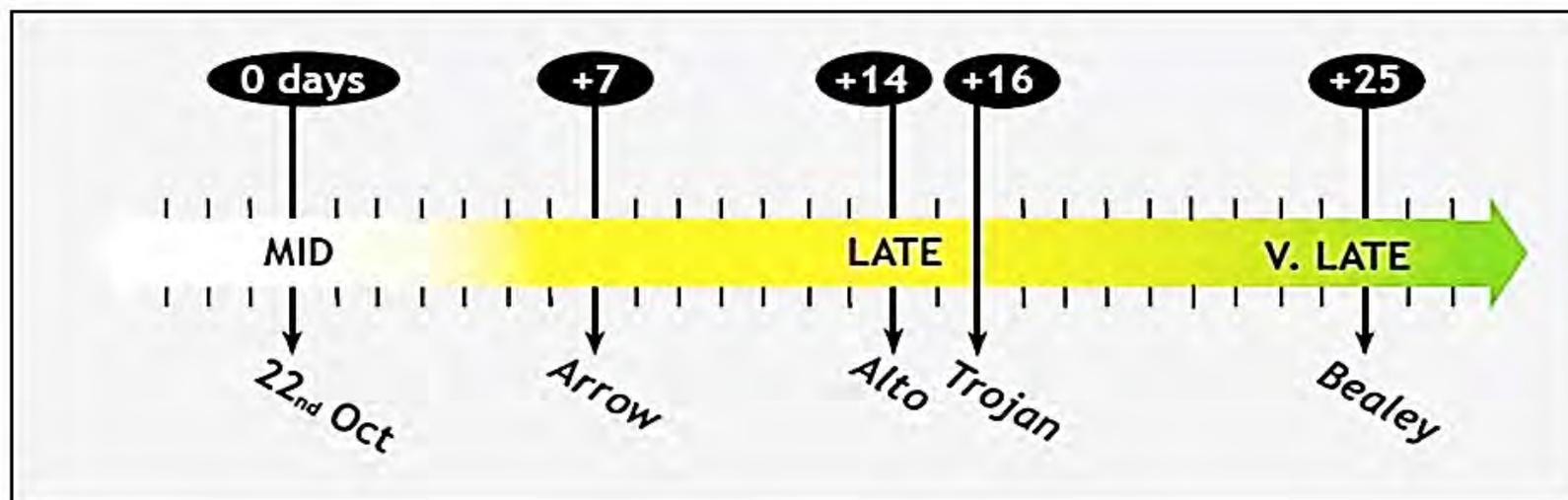
Ryegrass endophyte strains

Endophyte strain	Peramine	Lolitrems B	Ergovaline	Janthitrem
Standard	High	High	High	-
Without	-	-	-	-
Endo5	High	-	Low	-
AR1	High	-	-	-
NEA2 or NEA	Low	Low*	Low-medium*	-
AR37	-	-	-	High

- = none produced; * depends on the specific endophyte strain(s), and ratio of strains, in the mix

Heading date

- Heading = flowering time in spring.
- Early heading - higher early spring growth.
- Late heading - late spring quality.

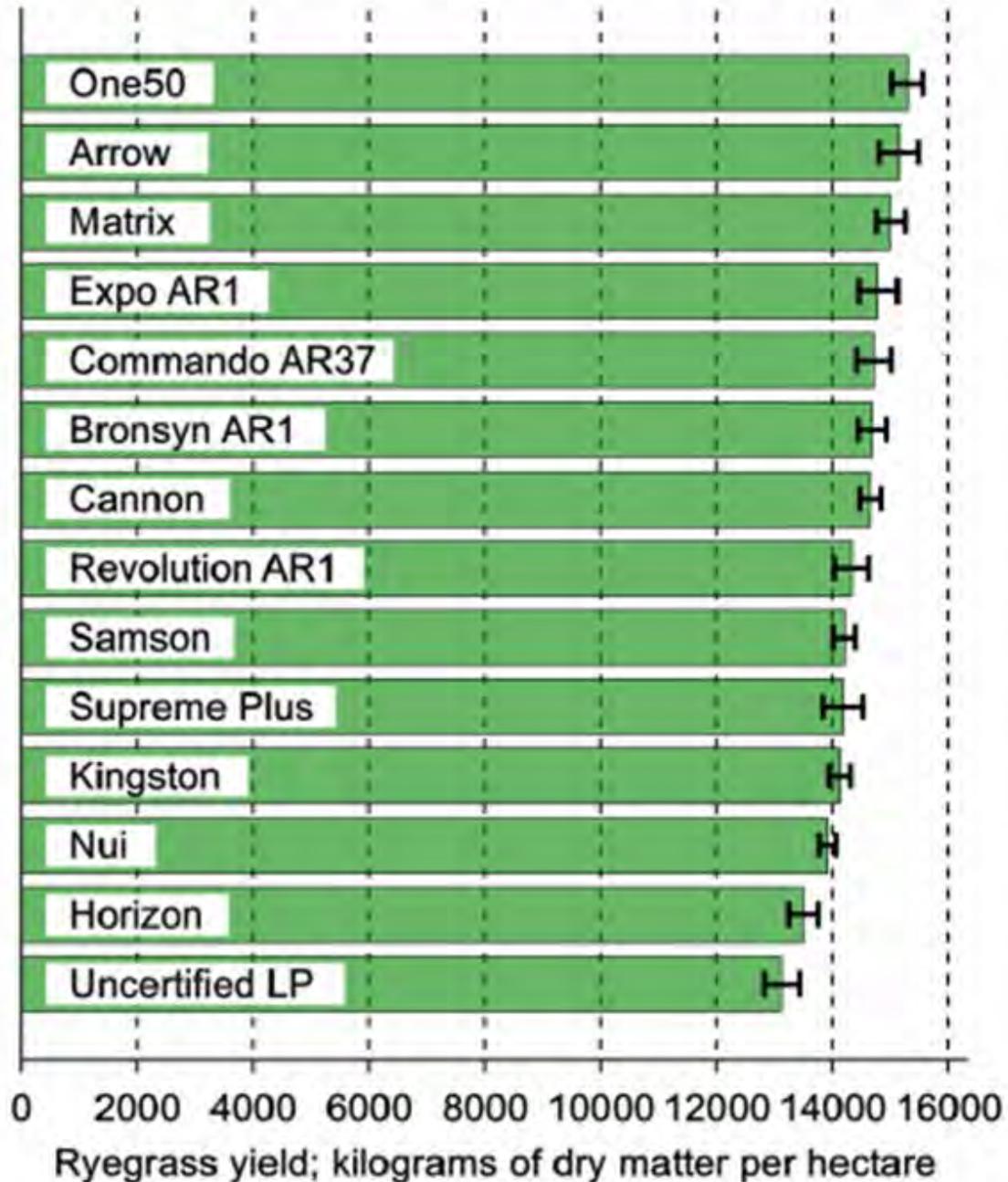


New Zealand's specialist land-based university



Forage variety trials

All New Zealand Trials Total Yield

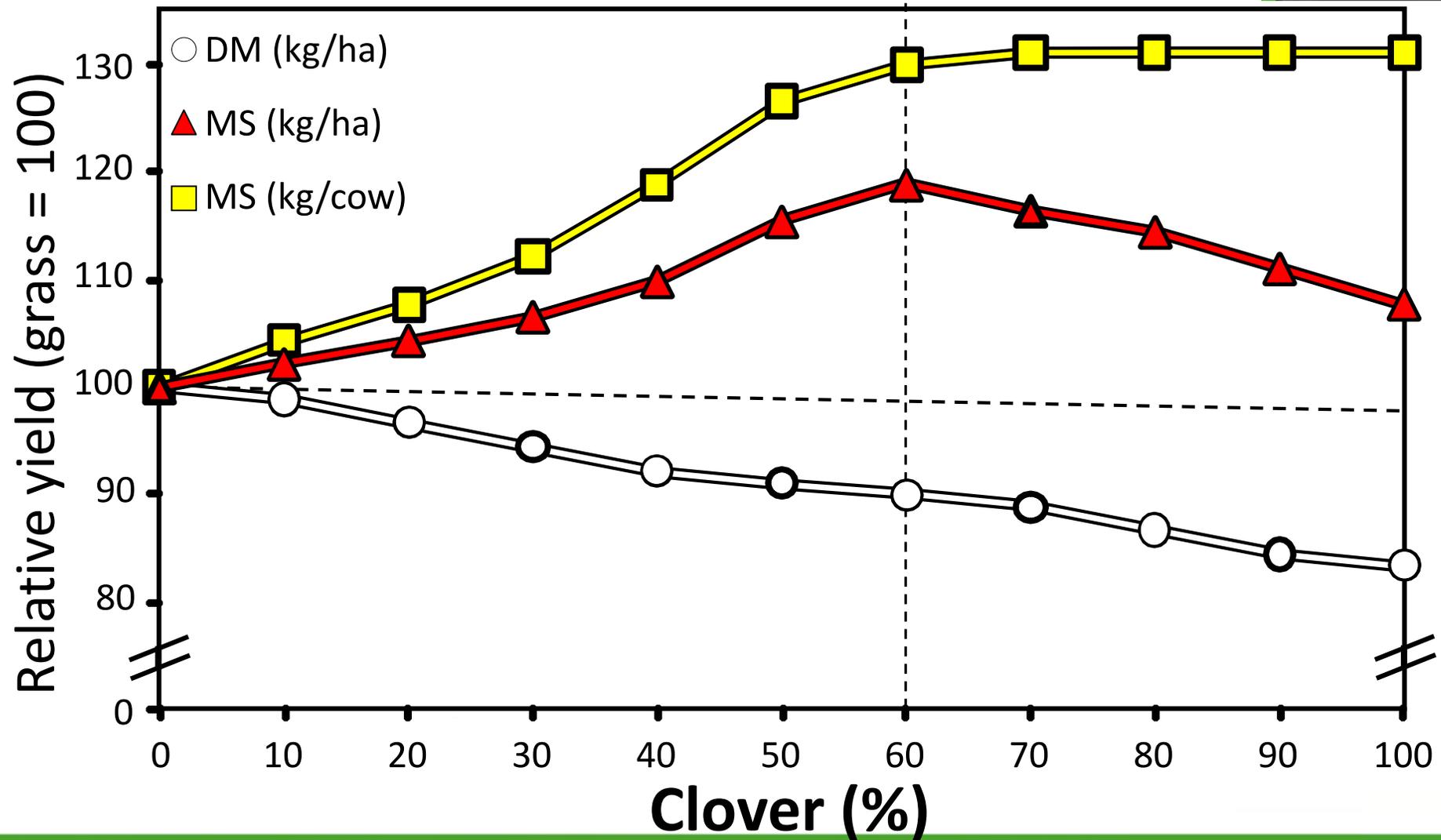


Perennial ryegrass cultivars

Sheep prefer 70% legume, 30% grass



Clover content & milksolids production





High feeding value pastures have;

- high legume content
- high leaf content
- low stem content
- young herbage age

40% white clover



How to get more legume??

- Grass is a WEED!!!! (in the eyes of clover)
- Understand competition: - Grass vs. Legume
 - Grazing preference
 - N, P, S, K – grass has more roots
 - Water – deep rooted perennials
 - Light – taller legumes?
- Management: -
 - Sow legume friendly grasses at low seeding rates
 - Grow legumes alone, overdrill grasses later?
 - Use a range of legume species & cultivars
 - Avoid N fertiliser on actively growing legume pastures



Olsen P>20



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

Olsen P<6

White clover

- Small seed (0.63 mg)
- Rapid germination and emergence but:
- Small seedling – needs light to produce leaves
- Establishment experiment (chicory 1.5 kg/ha)
 - Dates = 4/2, 26/2, 19/3, 9/4
 - Rates = 0, 4, 8, 12, 16 kg/ha ryegrass

A close-up photograph of numerous perennial ryegrass seeds. The seeds are elongated, spindle-shaped, and light brown in color, with a slightly glossy surface. They are densely packed and oriented in various directions.

Perennial ryegrass

2.0 mg/seed

A close-up photograph of numerous white clover seeds. The seeds are small, rounded, and vary in color from light yellow to dark reddish-brown. They are densely packed and fill the entire frame.

White clover

0.63 mg/seed



Ryegrass sowing rate



**White clover
@ 4 weeks
after sowing**

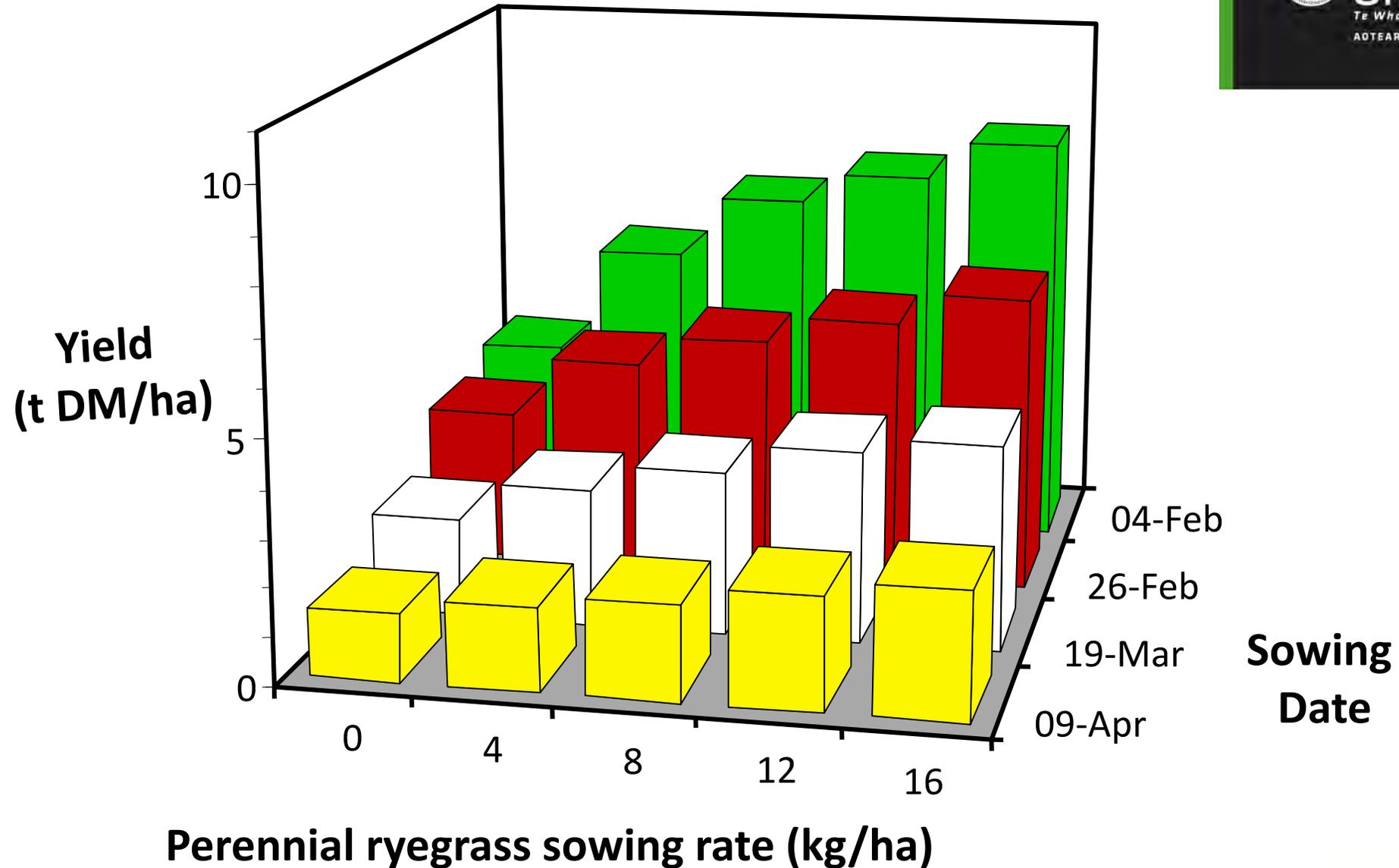


**Perennial
ryegrass @ 4
weeks after
sowing**

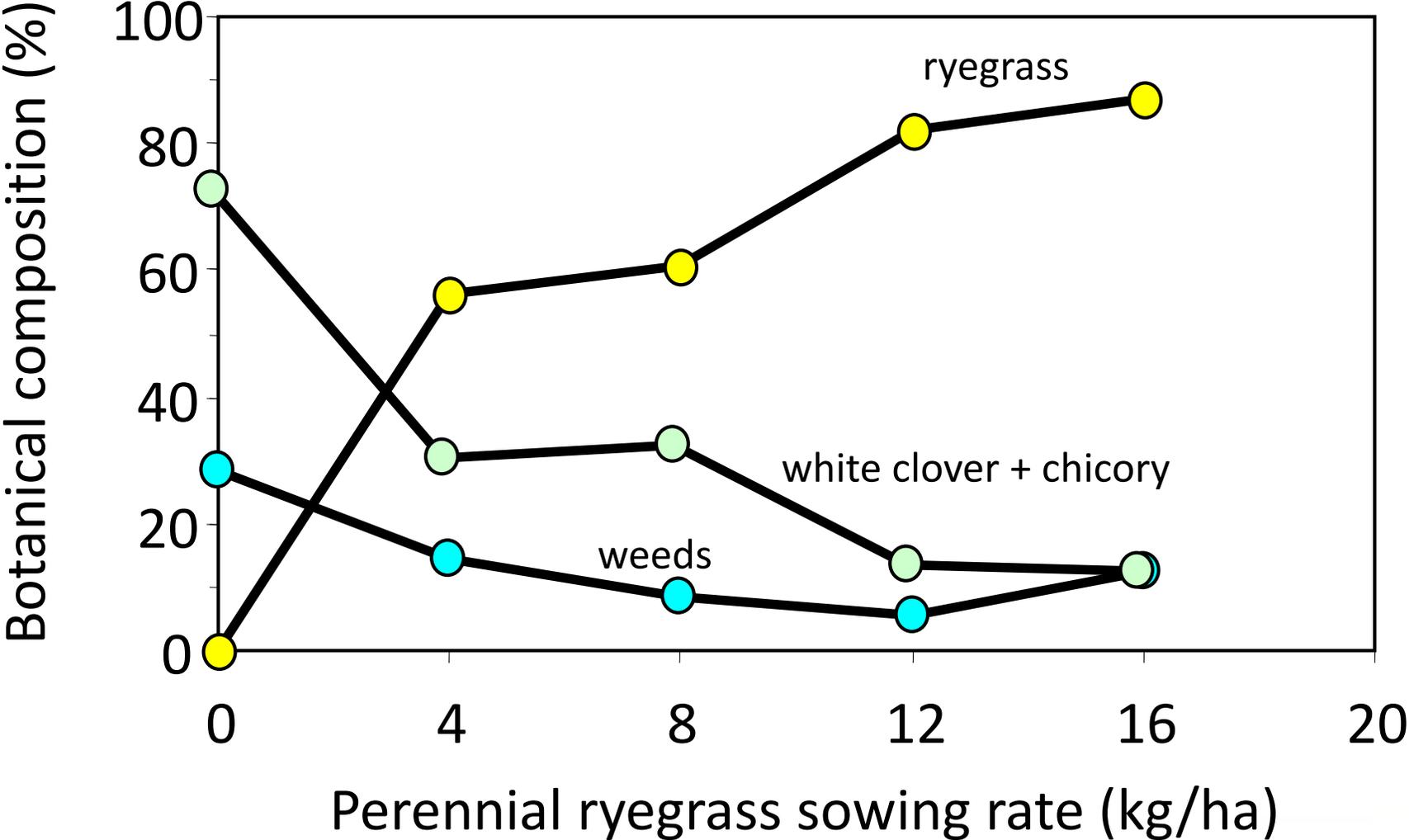


**Italian
ryegrass @ 4
weeks after
sowing**

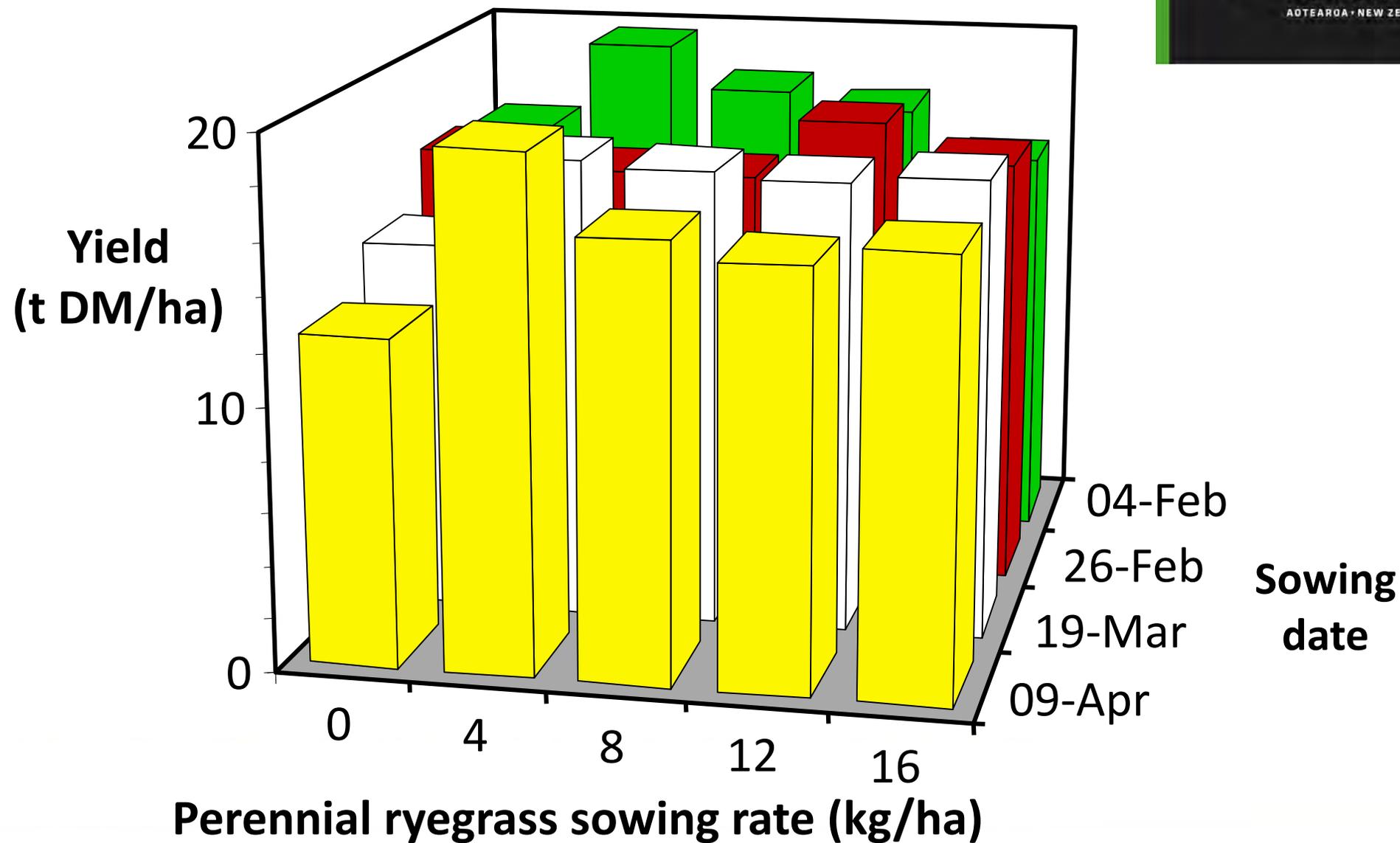
Total yield in Year 1 (25/9)



Botanical composition



Total yield in Year 2



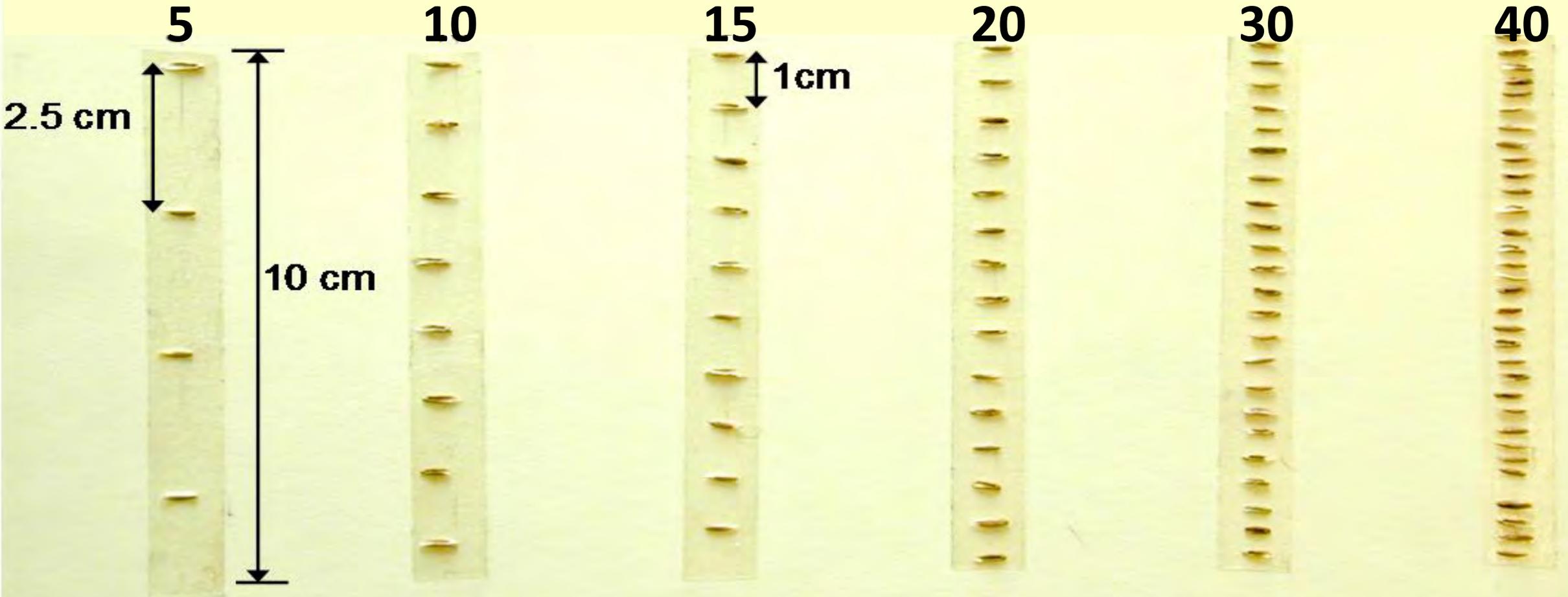
Number of seeds sown /m²

Ryegrass sowing rate	Ryegrass (seeds/m ²)	White clover (3 kg/ha)	Chicory (1.5 kg/ha)	Total (seeds/m ²)
0	0	420	120	540
4	200	420	120	740
8	400	420	120	940
12	600	420	120	1140
16	800	420	120	1340
20	1000	420	120	1540

Perennial Ryegrass Seed Spacings

15 cm Drill Rows

Sowing rates (kg/ha)



Summary: White clover

- Autumn sowing
 - soil temperature $>14^{\circ}\text{C}$
- Drilled with 4-8 kg/ha ryegrass in a well prepared seed bed!
- Nutrients (P) maintained
- Manage for white clover (18 months) and each spring!
- Chicory and plantain increase complexity of weed control

New Zealand's specialist land-based university

Caucasian clover

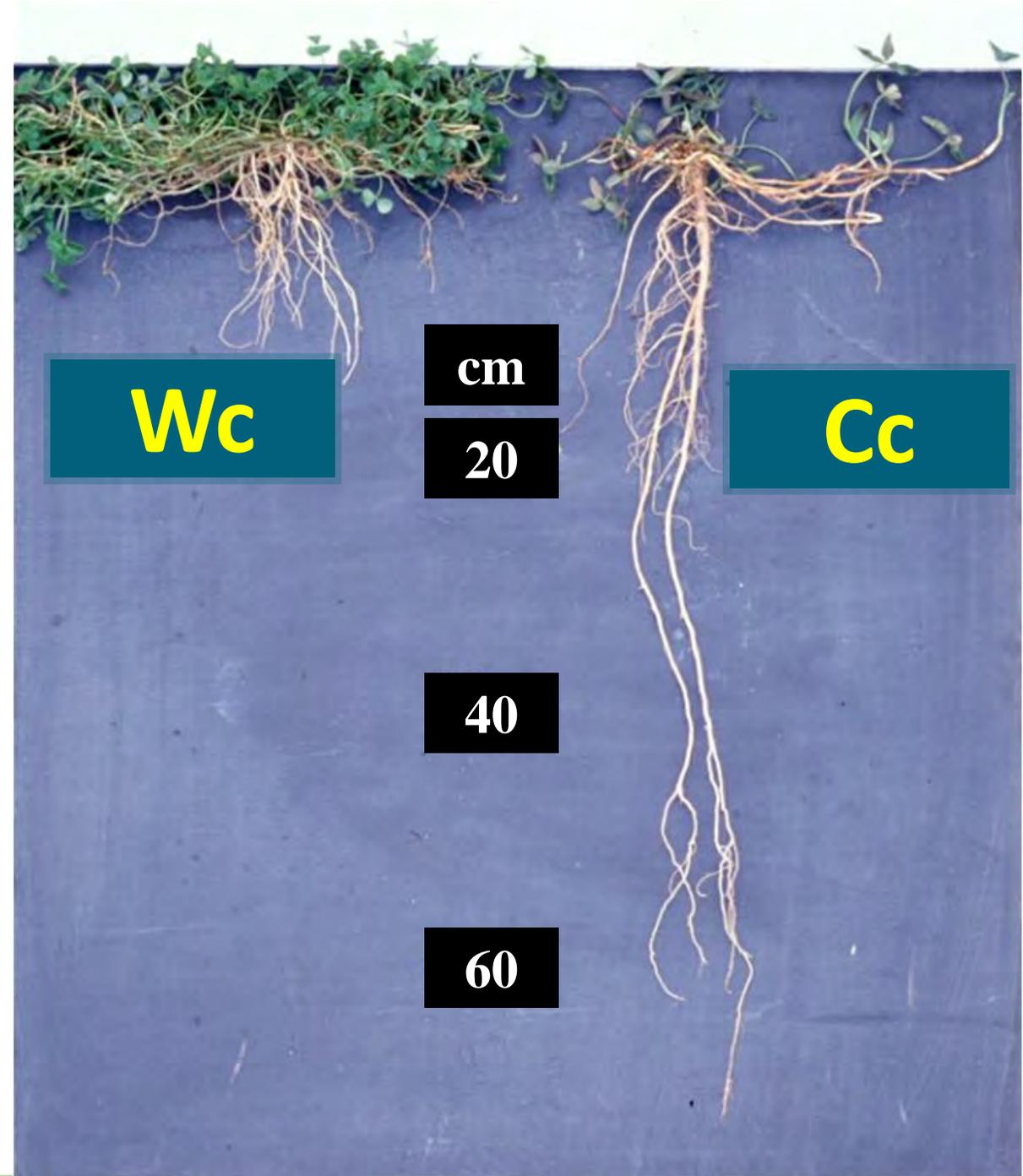
- Germination and emergence = RG/Wc but:
- Slow seedling development (leaf appearance)
- Why bother?

Growth in the field
20 month old white clover plants
– grazed by sheep

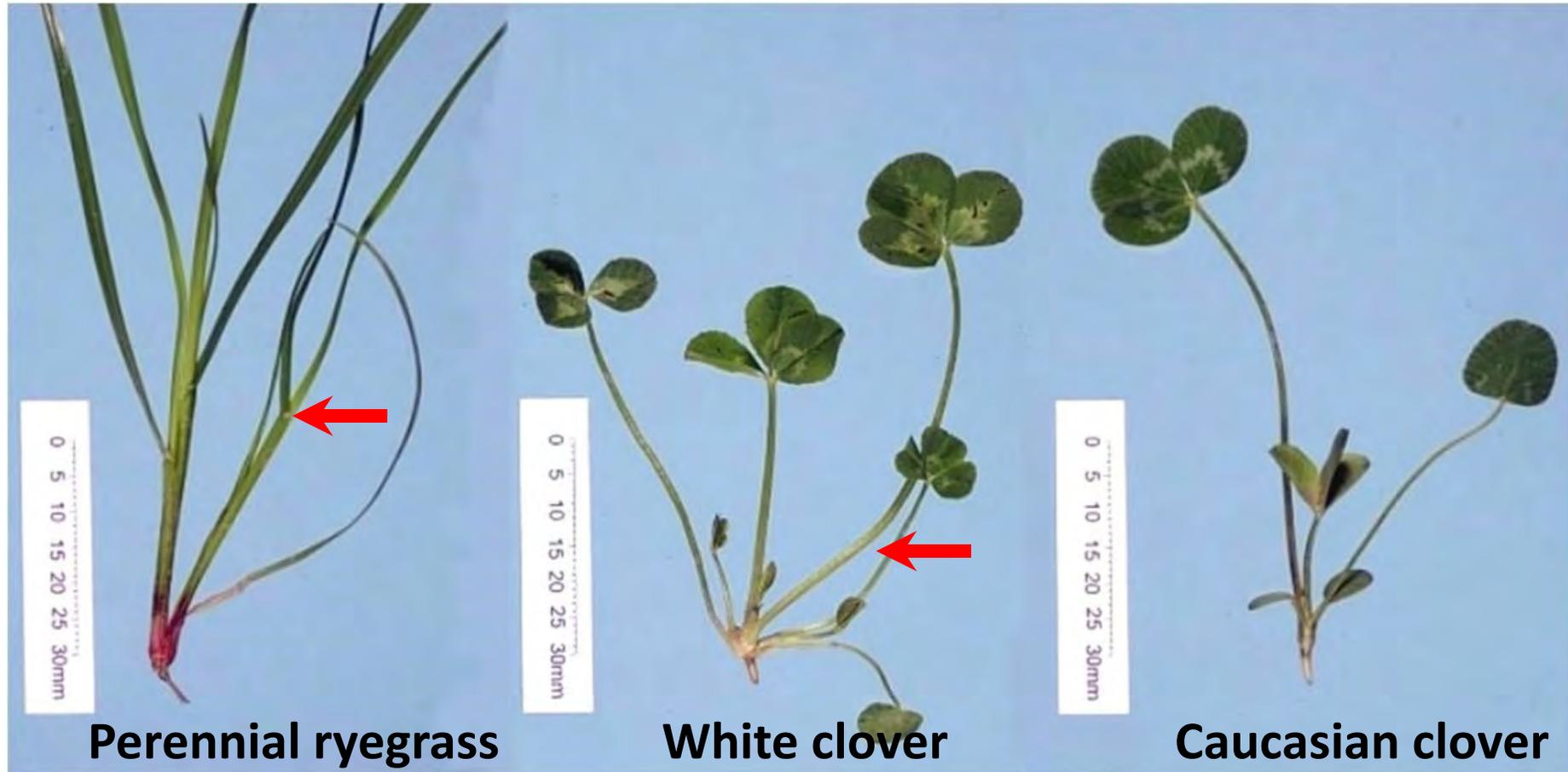


Widdup *et al.* 2003

2 years after sowing



Seedlings at 28 DAS



New Zealand's specialist land-based university



8 kg/ha perennial RG
4 kg/ha Caucasian clover
2 kg/ha white clover



9 year old pasture



Tall fescue/Caucasian

90% cover, 60% clover DM on offer



Temporal separation

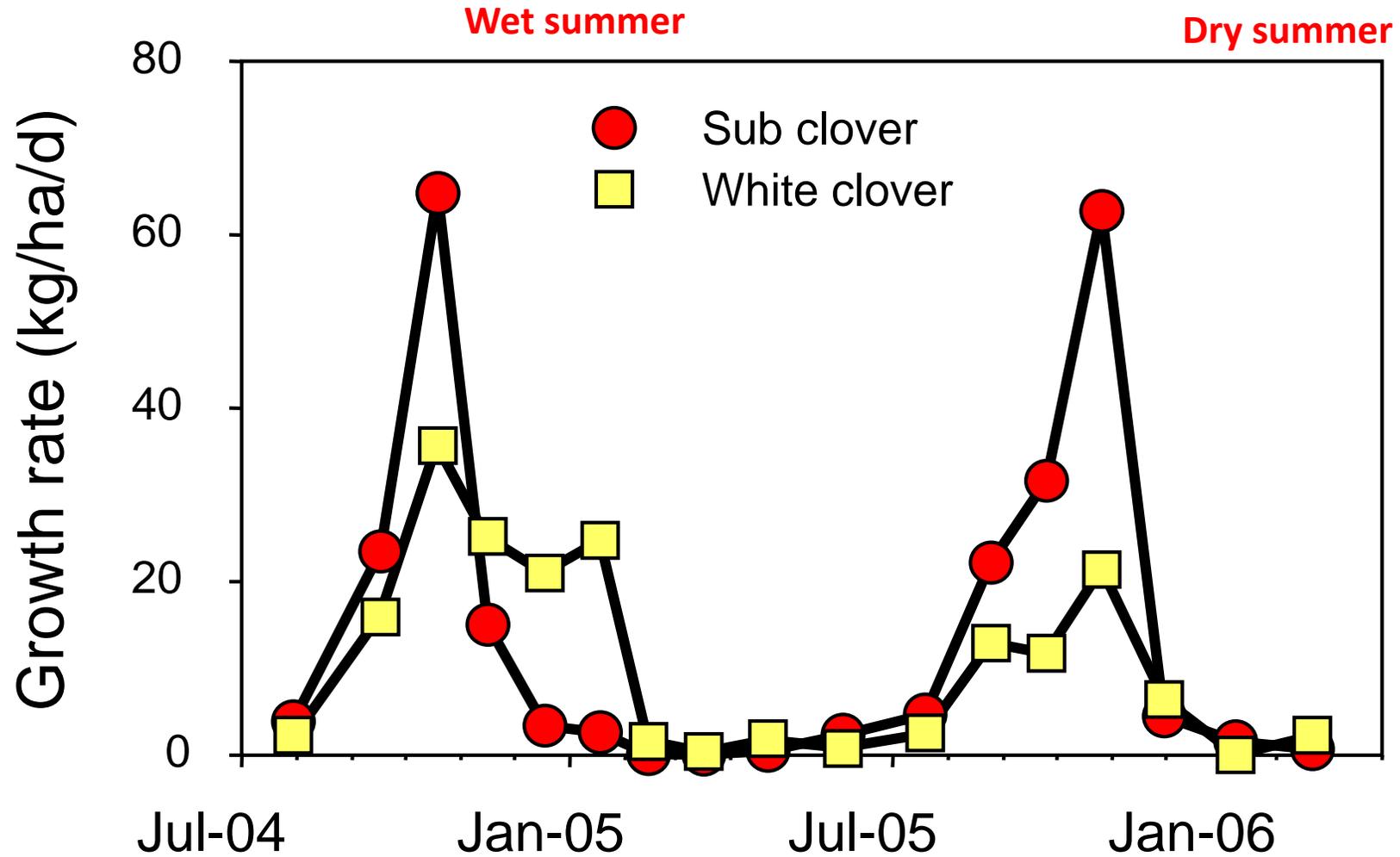
Sub clover grazing management

New Zealand's specialist land-based university

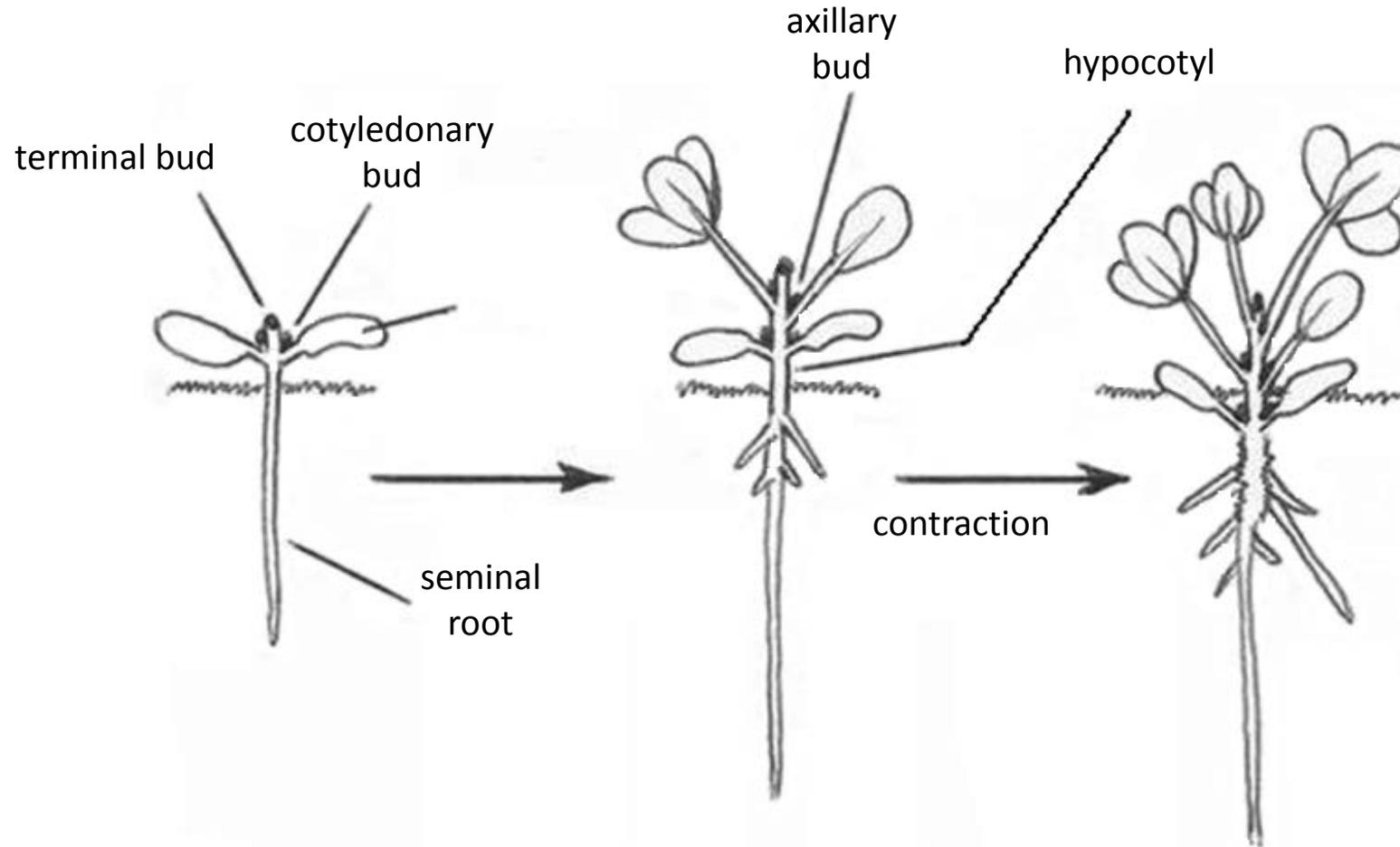
Subterranean Clover

- Large seed, 10x Wc therefore 10x sowing rate
- Winter annual – autumn sow soil temp. $<11^{\circ}\text{C}$
- Rapid but variable germination with rainfall from Jan-May
- When can seedlings be grazed in autumn?
- How to maximize summer seed set

Seasonal clover growth



Seedling Development



New Zealand's specialist land-based university



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

New Zealand's specialist land-based university

- *Direct drill before rain*
- *Initial population for seed build up*



Autumn Management in later years

(200 seedlings/m² in pasture)

- High strikes after extended hot periods
 - bare ground for seedlings to establish in
 - high temperatures break dormancy
- January rains are often false break
 - seedlings die (March is usual)
- Amount of cover in autumn is crucial



seedling





1. 4. 2003



5.4.2003



9. 4. 2003



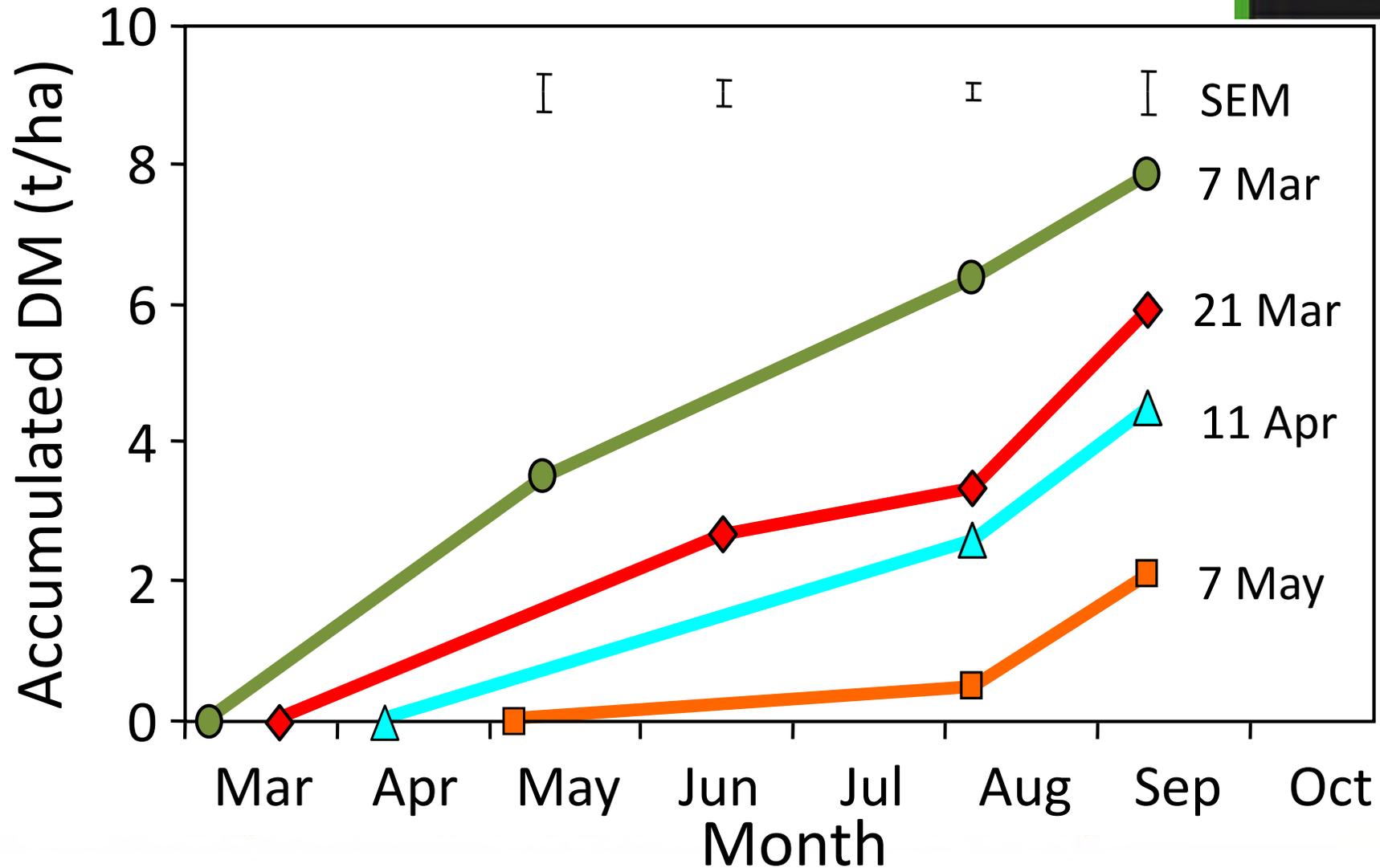
12. 4. 2003

Seedling density is what gives us fast recovery



1.5.2003

Dry matter yields







20.10.2003

Takes several years to build seed reserves



27. 10. 2003

Dryland Pasture Mix

- 8 kg/ha AR1 or AR37 Ryegrass
- 6-10 kg/ha subterranean clover
 - early and late flowering cultivars
- 1.5 kg/ha White clover
- 1 kg/ha Cocksfoot

- Hill country = 10 kg/ha sub (2 flowering dates)
- Direct drill into grass dominant swards

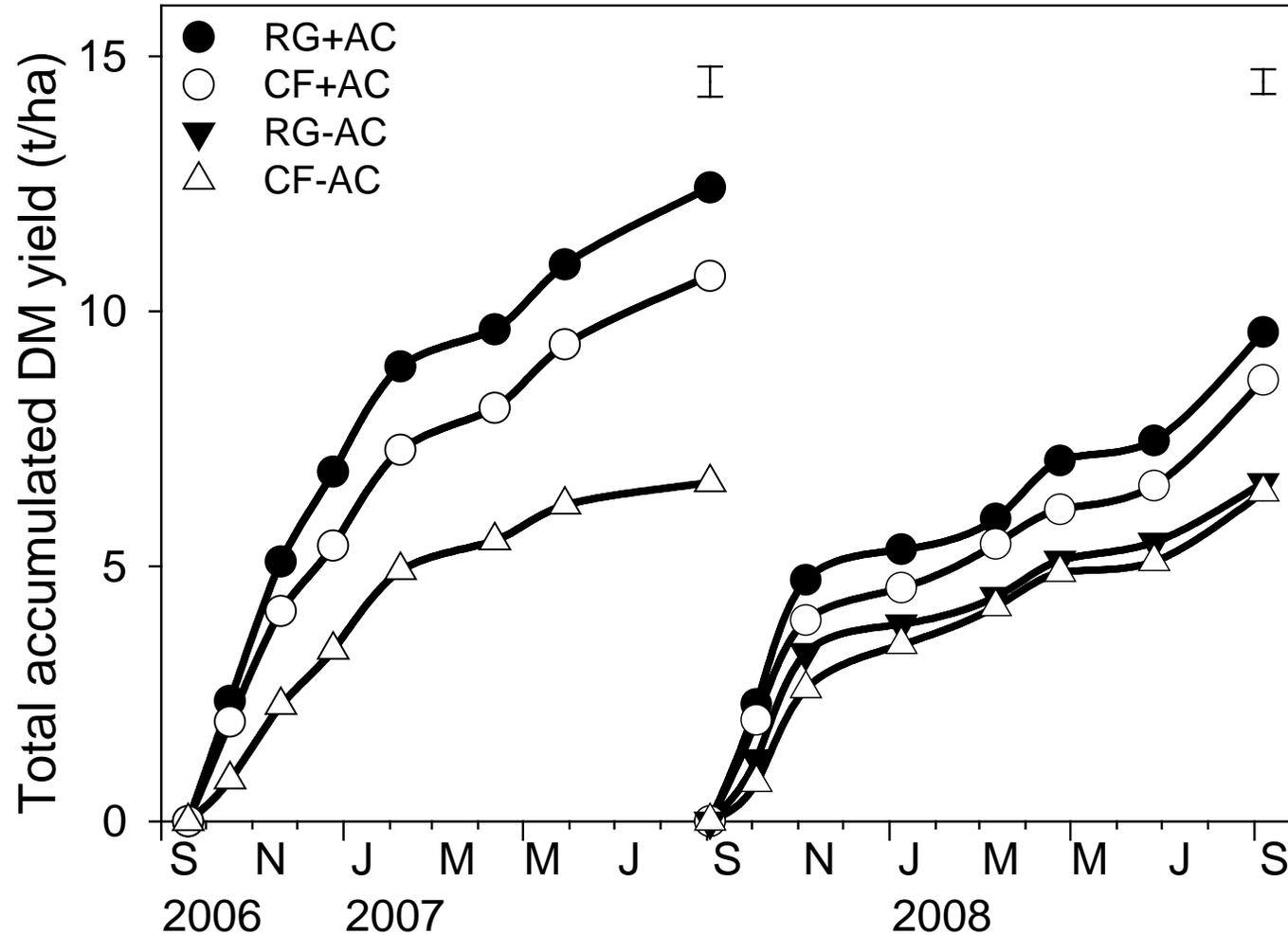
Yield increased 40% when Sub clover was over-drilled into grass-dominant dryland pastures



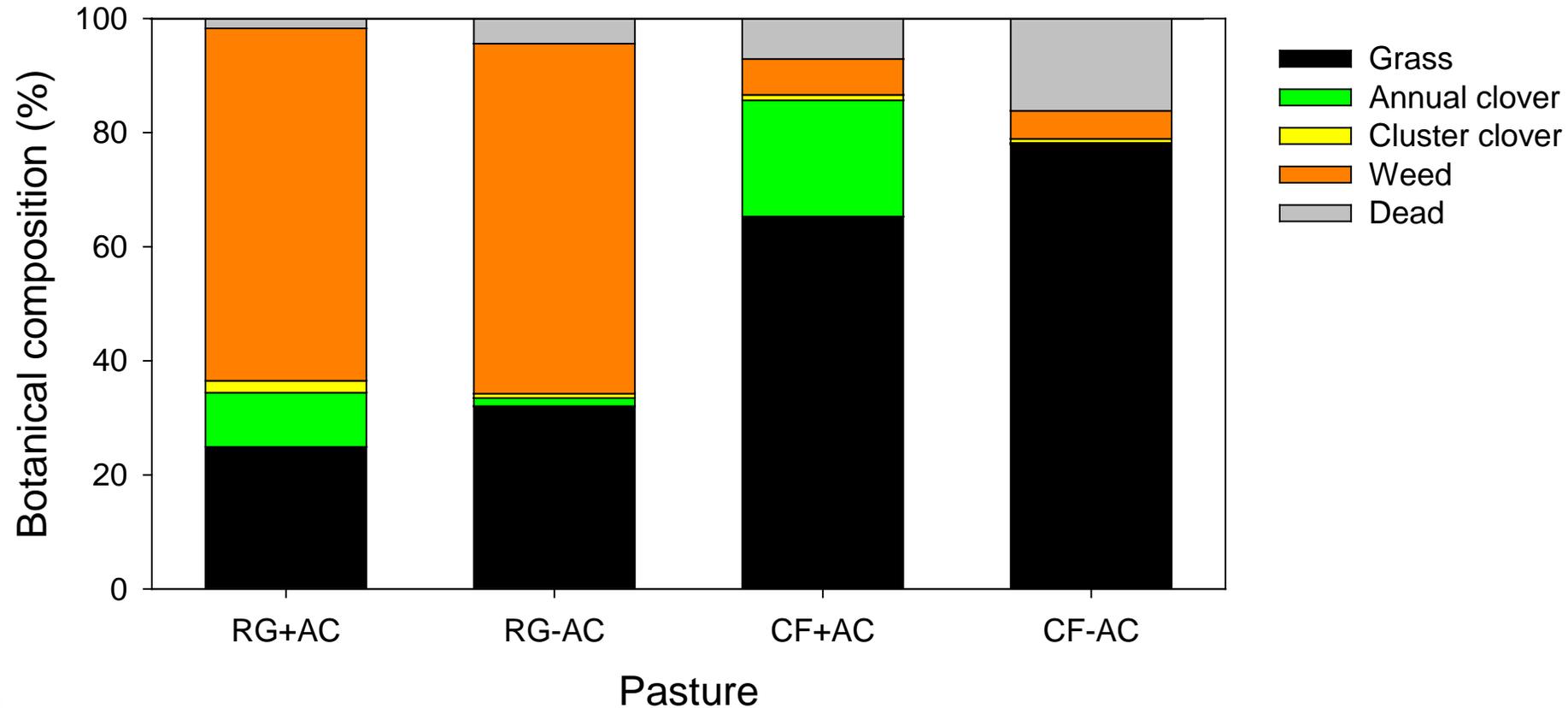
S. ATES, M.O. TONGEL & D. J. Moot

New Zealand's specialist land-based university

Total DM yield



Botanical composition – 26 June 08



New Zealand's specialist land-based university

Tempello



David & Joanna Grigg

- Website: www.lincoln.ac.nz/dryland
- Field Day handouts and presentations page (18 June 2012)

Tempello

- 4800 ha steep/rolling hill (2600 effective)
- 4500 sheep su
- 5200 cattle su
- Sub-clover key legume
- Any summer legume a bonus

New Zealand's specialist land-based university

Tempello - commentary

- Legumes are really only present in spring and autumn, if it is good.
- Very short window of opportunity in spring with summer dry settling in by end of November.
- Key growth period runs from late August to end of October. Growth rates of 50 kg DM/ha/day are not unusual for October. This is the difference between mainly store or prime lambs. With the volatile seasons it is becoming more and more a boom and bust scenario so making the most from any sort of Spring is paramount.
- Although rainfall is often the limiting factor pasture management and fertility play a big part.
- We grow around 65% of our feed in a 90 day period starting 5th September going through to late November early December which is about 4500-5000 kg/DM/ha.

Tempello - commentary

- We are a semi extensive property with the main development opportunities lying in further sub division on the hill country.
- Sub-clover is our predominant legume species on the hill country. This was first established in the 70s through aerial oversowing and top dressing. RATES for the oldies amongst us were 2 pounds white clover and 3 pounds sub clover and 20 ryegrass to the acre. Translated for those born in the modern era this is around 3 kg white clover 4.5 of sub and 24 ryegrass. This was sown with 600 kg per ha of potash super. Cultivars of sub used were Mt Barker and Woogenellup
- Our hill blocks range from Olsen P of 10 to 18 and the soil pH range is 5.5 to 6.
- Generally our sulphur levels are good ranging from 7 - 10.
- Of latter years our fertiliser focus has changed to a lime sulphur viaphos application with added trace elements to create the right balance.

Woog is by far the more dominant of the two major species of sub



Photo: Keith Pollock
Lincoln University

Woogenellup sub clover

Mt Barker is the other cultivar characterised by the red bands on the flowers



Photo: Keith Pollock
Lincoln University

Mt Barker sub clover

Advantage of legume \$179/ha for Corrie and Corrie/PD system in 600 ha key lamb production area of Tempello



	Drought (900 kg DM/ha) low clover and low grass	Grass dominance (<5% legume)	Ideal legume (up to 60% sub clover)
kg lamb weaned	27	30	34
Value \$3/kg store and \$6.80 kg killed	\$81	\$90	\$113 to \$130
Advantage	\$0	\$9	\$32 to \$49
Over 2200 lambs	\$0	\$19,800	\$70,400 to \$107,800
Per ha advantage (600 ha area)		\$ 33	\$117 to \$179

How do we get a high sub-clover diet?

- Clovers over sown 1970s
- A hill block gets shut up every 8-10 years in spring, to build seed bank (one block/year).
- Identify low legume blocks and try and graze before march rain, then leave until 5 trifoliate leaves.
- May have to sacrifice any early 'false strikes'

Winter & Spring

- Thump grass/established legume in winter
- Spring: don't graze until post-flowering mid-December
- Reap the rewards the following spring!
- On-going management includes spelling 2 months prior to lambing. Use crops.



Sub division key

These photos are from the Legume Photo Diary site at Tempello.

The rank stuff (left) is pre-grazing late summer and on the right, is pasture that was partially grazed late February setting it up for germination.

Not totally cleaned up but some cover does provide shade for young seedlings





Grass out of control. Fence!

This photo illustrates the down side of Tempello. Total suppression of any clover and consequently poor lamb growth are direct results

Weaning weights of 27 kg were achieved that spring. If we had better control things could be a lot different. That type of feed would not maintain ewes later into the summer.



Meadowbank, Marlborough

Pete Anderson in clover

Getting to 20 ha blocks worth it

- \$176 extra/ha justifies \$300k spend on fencing/water? **Yes**
- Increased from 60 to 76+ tonnes lamb meat with 600 fewer ewes
- Still 8 su/ha this area
- Extra ewe grazing days
- Lamb income 2011 would have been \$65k lower if no changes made

LEGUMES AT MEADOWBANK

We're in clover

Will Grigg

Website: www.lincoln.ac.nz/dryland

Field Day handouts and presentations page (20 June 2013)



BACKGROUND INFO

- 2800 ha, 2400 ha effective
- Topography
 - 140 ha Flat (excluding vineyard)
 - 250 ha Cultivable hill – developed
 - 40 ha Cultivable hill – yet to be developed
 - 800 ha Medium hill
 - 720 ha Steep hill
 - 850 ha Very steep un-topdressed
- 600 mm annual rainfall

OBJECTIVES THAT DETERMINED WHAT TO SOW

**Twin lambs 17 kg+ cwt at weaning.
48 kg+ hogget mating weight.
140% + lambing.**

- Good pasture production without N from bag.
- Autumn, winter, spring production our strength.
- Enough summer production to grow young capital stock.
- Efficient use of water – deep rooting species.

MEADOWBANKS CLOVER MIX

Finesse Q tall fescue	15 kg/ha
Prairie grass	8 kg/ha
'Woogenellup' Sub clover	6 kg/ha
'Arrotas' arrowleaf clover	2-3 kg/ha
'Huia' white clover	2 kg /ha
'Tonic' plantain	2 kg/ha

60 ha with winter active fescue
70 ha with Finesse Q fescue.





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



Finesse Q fescue, Prairie grass, Sub and Arrowleaf clover and plantain mix November 2011



Grazing late November after letting sub clover flower and set burrs.



Grazing after shutting up for sub clover seeding.





Arrowleaf clover flowering January 2011



Close up of germinating clover seedlings on 1 May







Close up of mix in last photo.

LUCERNE AT MEADOWBANK

- 61 ha sown and 25 ha in renewal all on flat.

Used for:

- Ewes with twins/triplets, finishing cattle.
- Replacement hoggets 48 kg+ at mating.
- Topping feed for ewes or hoggets.
- Finishing lambs if we have a genuine surplus of feed.

Lucerne monoculture - January 2011.

Fantastic feed for growing replacement hoggets to good mating weights.



LUCERNE, PRAIRIE GRASS, PLANTAIN MIX

Lucerne (with peat inoculant)	9 kg/ha
Prairie grass	20 kg/ha
Tonic plantain	2 kg/ha

- High sowing rate for hill.
- 70 ha sown, 80 ha still to go.

Autumn drilling Italian ryegrass 2013 as part of the hill development.

This is destined to go into a lucerne mix in spring 2014.



- **'Omaka' barley six days after drilling on 6th February.**
- **All autumn drillings are summer fallowed by spraying out late October the year before.**
- **This block will be sprayed out in September and again in mid October before drilling into lucerne.**





First graze of Omaka barley in April after February sowing.



- **Lucerne/prairie grass/plantain mix in late January 2013.**
- **This was sown October 2012 and was first grazed late March 2013.**
- **This block of 16 ha is just about to be split into five paddocks and water troughs installed.**

Lucerne, prairie and plantain mix in October 2012.

**Running twin ewes and lambs at 12 ewes /ha and 1 finishing heifer or
steer/ha.**

The stand is 2 years old.



Lucerne/prairie mix sown Oct 2011.

We added cocksfoot @ 2 kg/ha in this block as a steeper harder face.



May 2013

- Lucerne monoculture in foreground winter spray just completed
- Hill block in background has lower half sown in lucerne/prairie/plantain, top half un-improved but has a lot of prairie grass from seed transferred up hill.
- Divided into 4 blocks of 3-4 ha with troughs at top and bottom so can split off un-improved from improved if required with hot wire.



WHAT'S HAPPENED TO PRODUCTION AT MEADOWBANK?

- Similar stock numbers , better fed.
- Ewe efficiency **increased 40%** since 2005

	2005	2012	Change
Ewe Lambing%	121%	142%	↑ 21%
Hogget Lambing%	60%	81%	↑ 21%
Weaning weight	28 kg/hd	34 kg/hd	↑ 21%
Return	\$730/ha	\$2640/ha	↑ \$1910/ha (>260%)



Twin hogget lambs at weaning
Killed 16.1 kg at 10 weeks
Averaged 410 g/hd/day.
All hogget lambs averaged 370 g/hd/day.



Lucerne 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)



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



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

“35% Rate of return on investment”



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



Integrating lucerne into a high country merino system

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

New Zealand's specialist land-based university

A large flock of sheep is gathered in front of a blue corrugated metal barn. The barn has the text "BOG ROY" and "EST. 1891" written on its side. The sheep are densely packed, filling the foreground and middle ground. The background shows a mountain range under a blue sky with some clouds. The scene is set in a rural, agricultural environment.

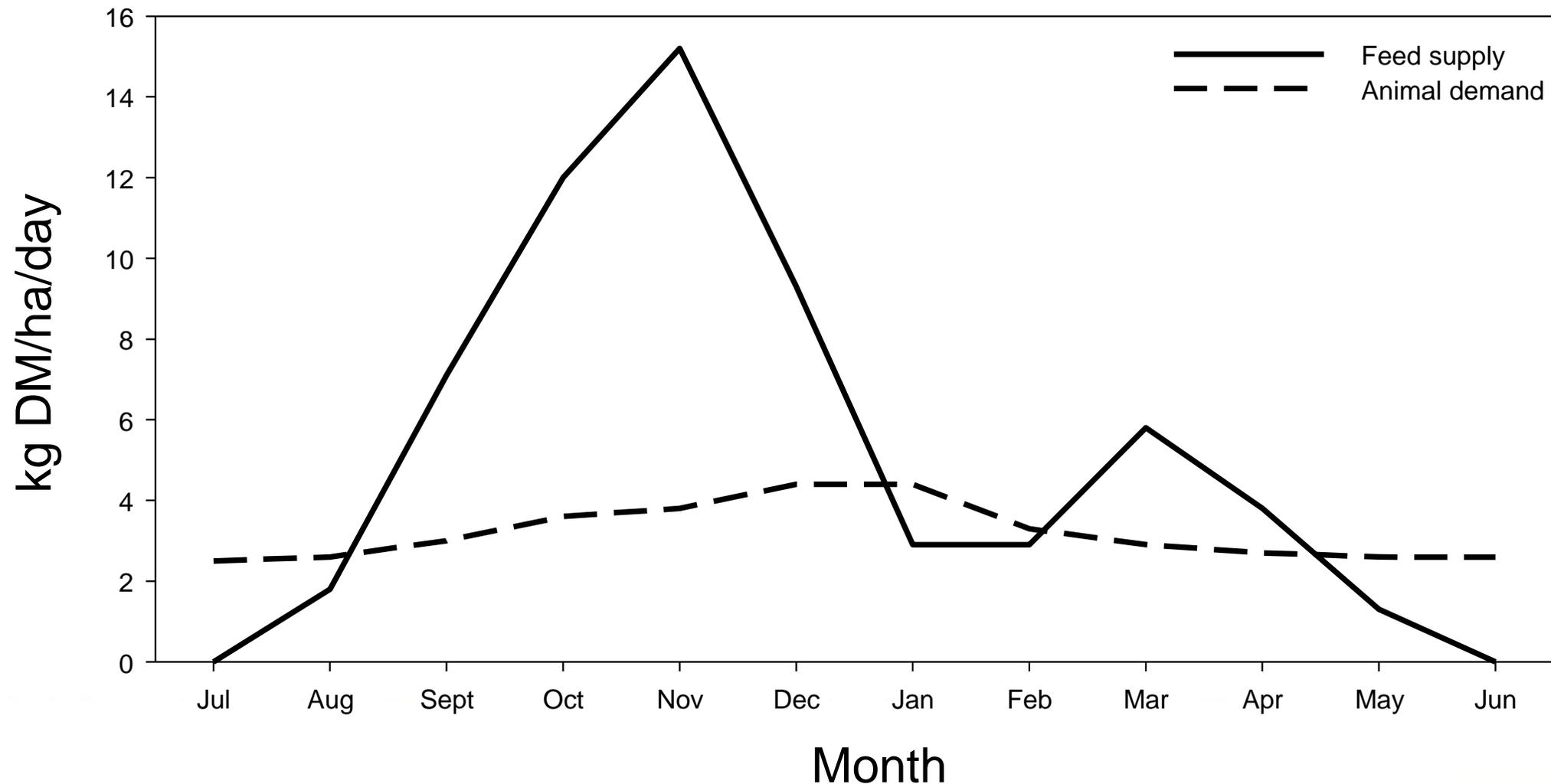
BOG ROY

EST. 1891

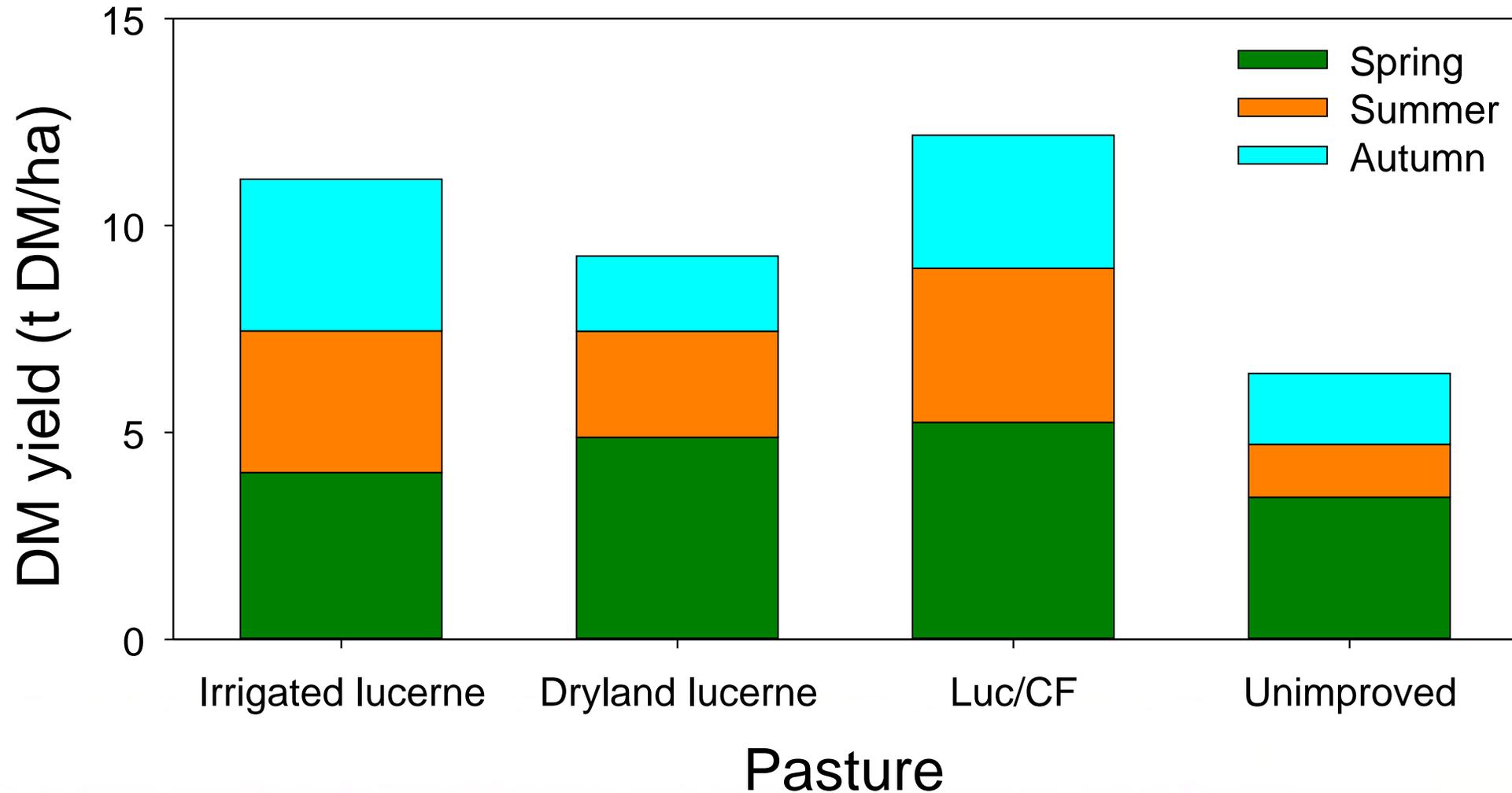
Landscape farming



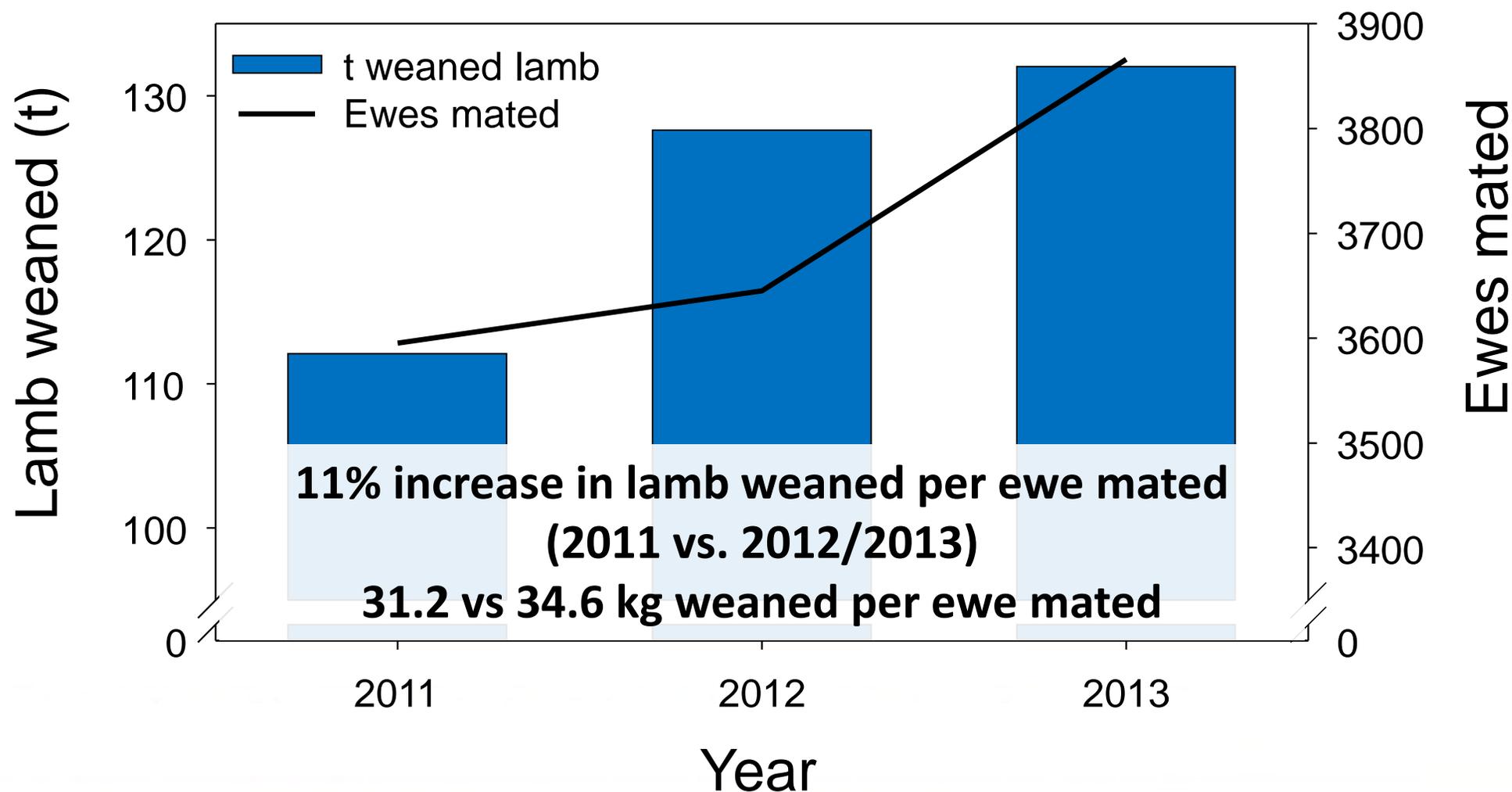
Pasture supply & Animal demand



Seasonal pasture production (3-yr average)



Lamb weaned and Ewes mated



Bog Roy change in system performance

	Historic (Pre 2010)	Year 3 (target)	Year 3 (actual)	% Change
<u>Mixed age ewes</u>				
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

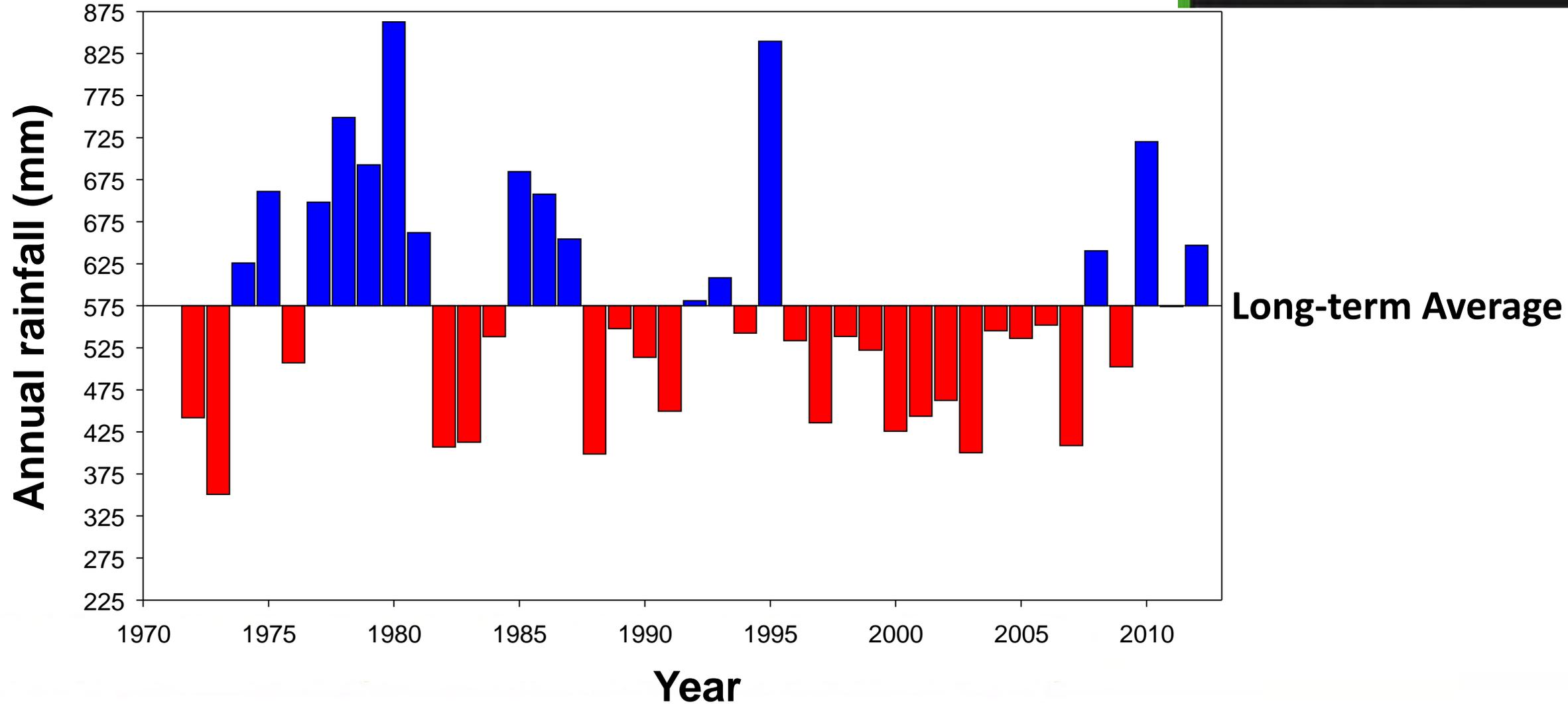
Case study – Bonavaree farm, Marlborough

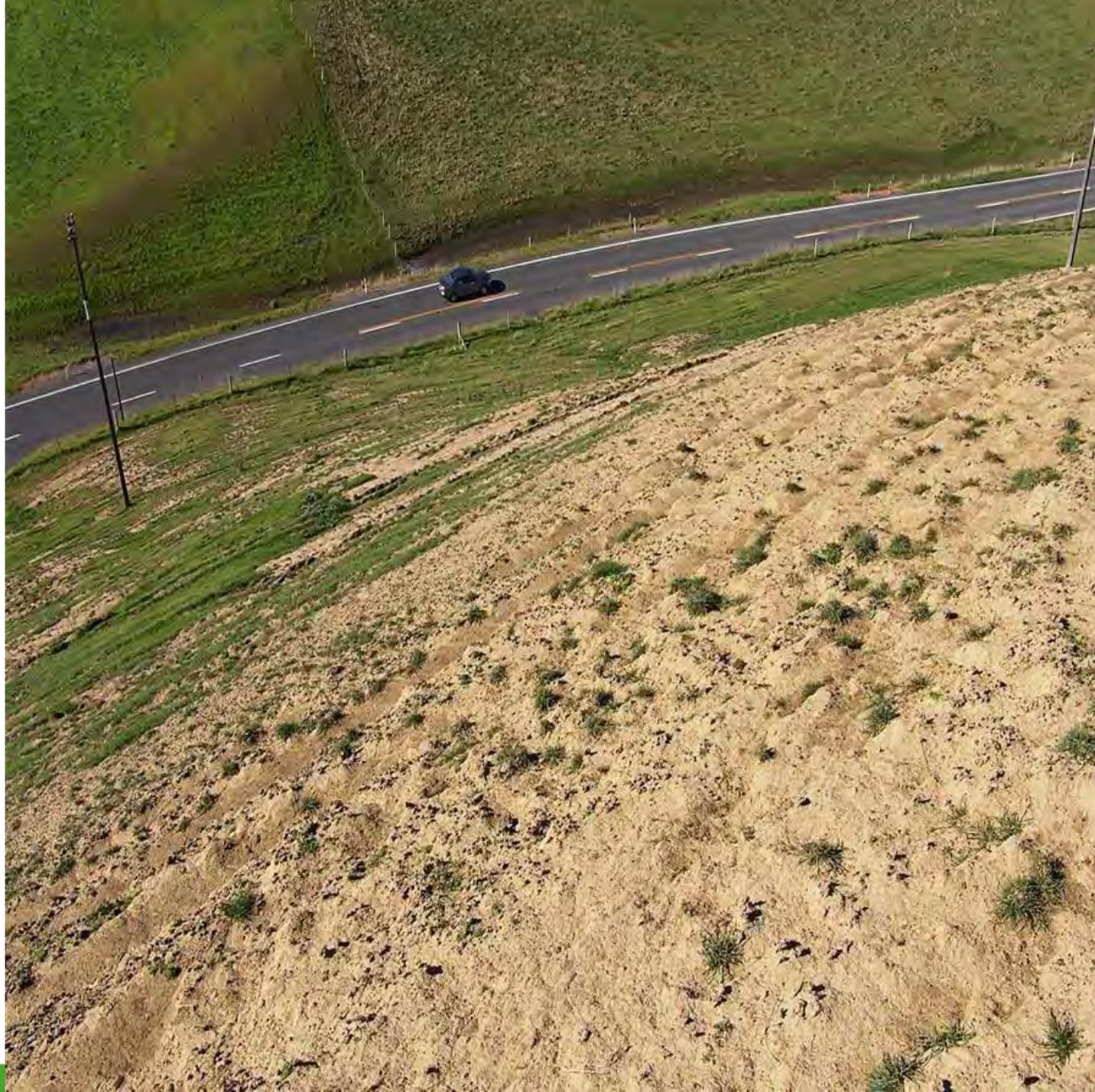
Over grazed – high erosion risk

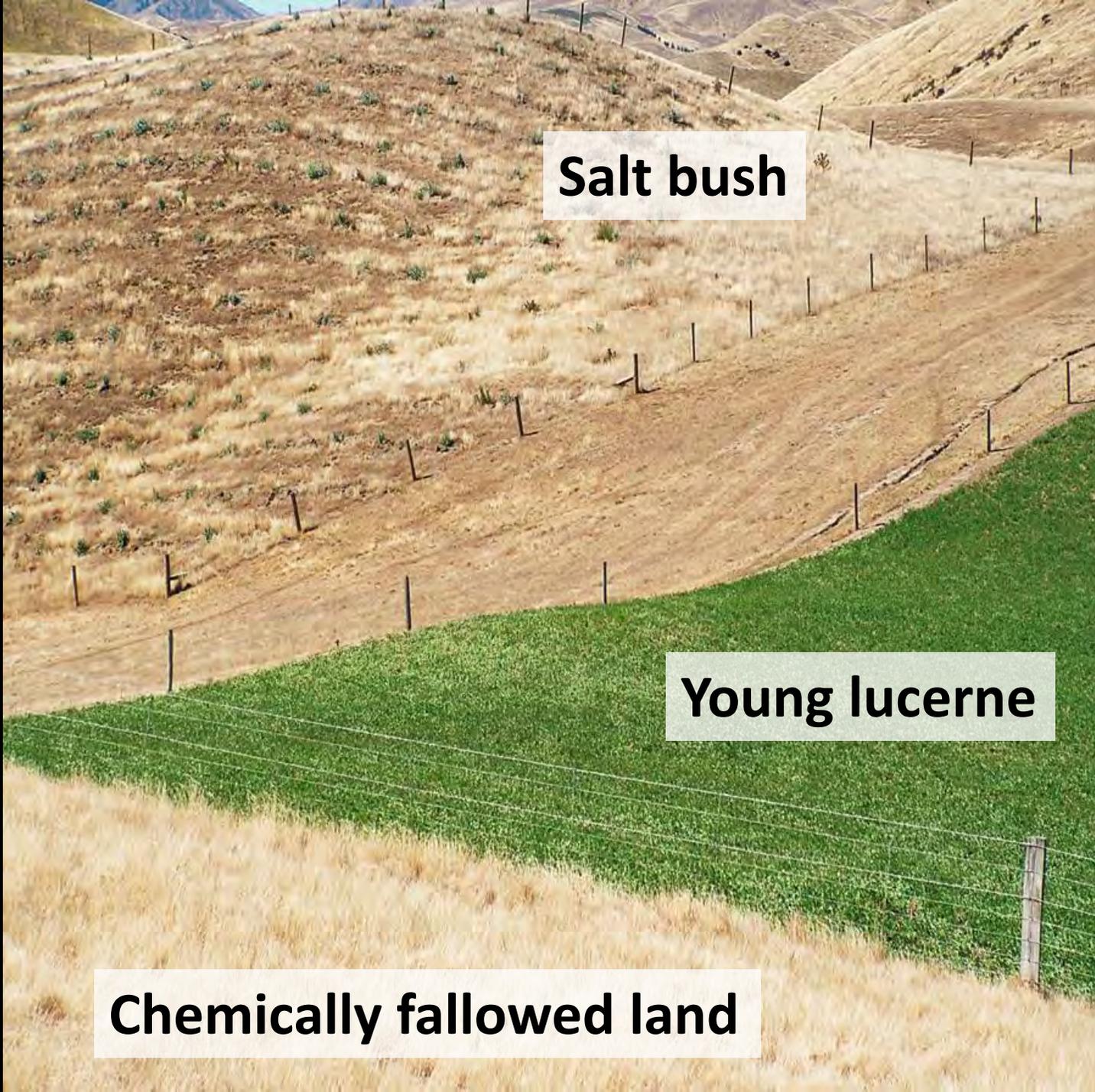


19/07/2004

Annual rainfall at 'Bonavaree'







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%







“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



Lincoln University Current Lucerne Research Programs

- **Luc/grass mixes**
- **Annual clovers for spring**
- **Lucerne oestrogens**
- **Lucerne Dormancy**

New Zealand's specialist land-based university

Sowing rate and date

Established 2007 LU – Templeton silt loam

Coated ‘Grasslands Kaituna’ lucerne.

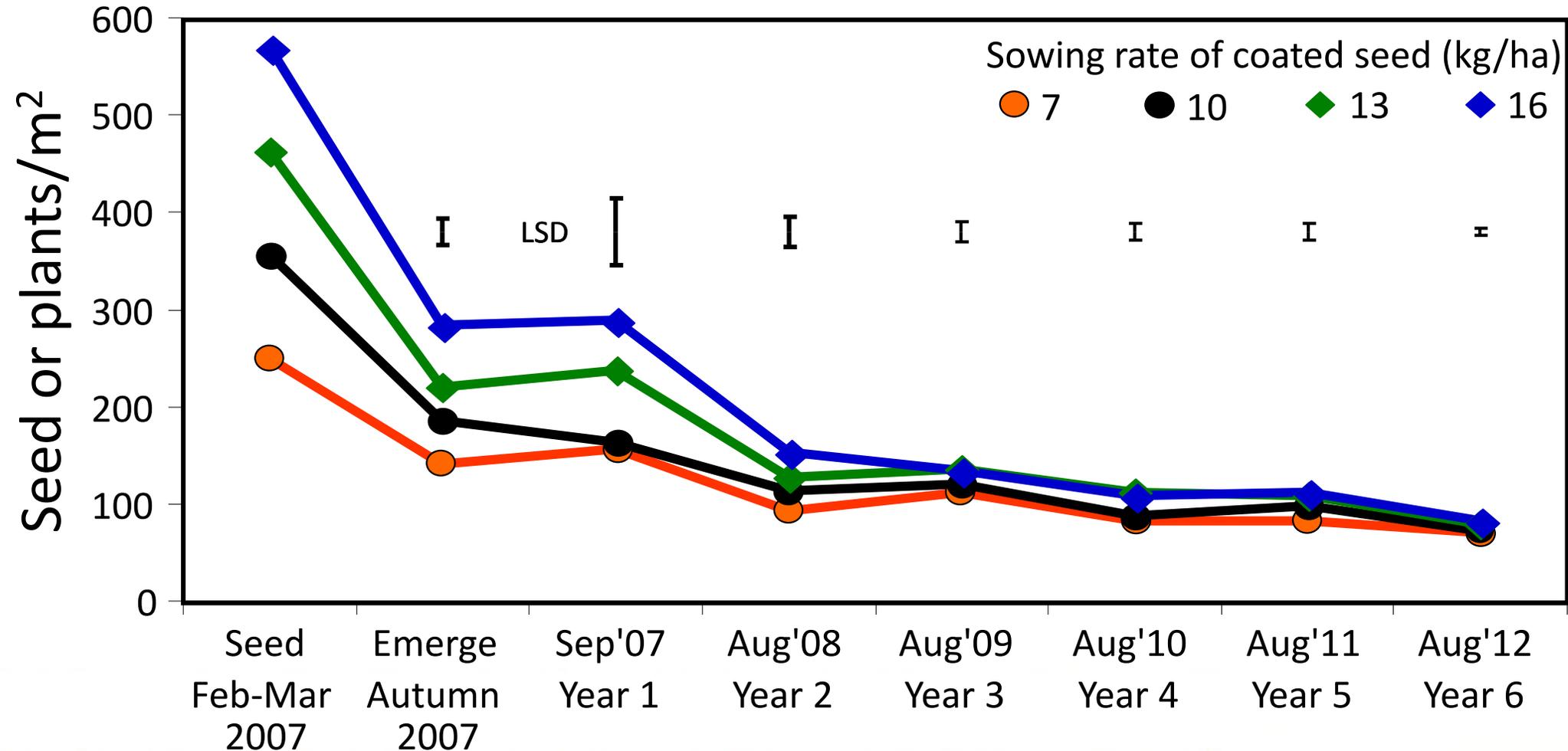
Four sowing dates

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

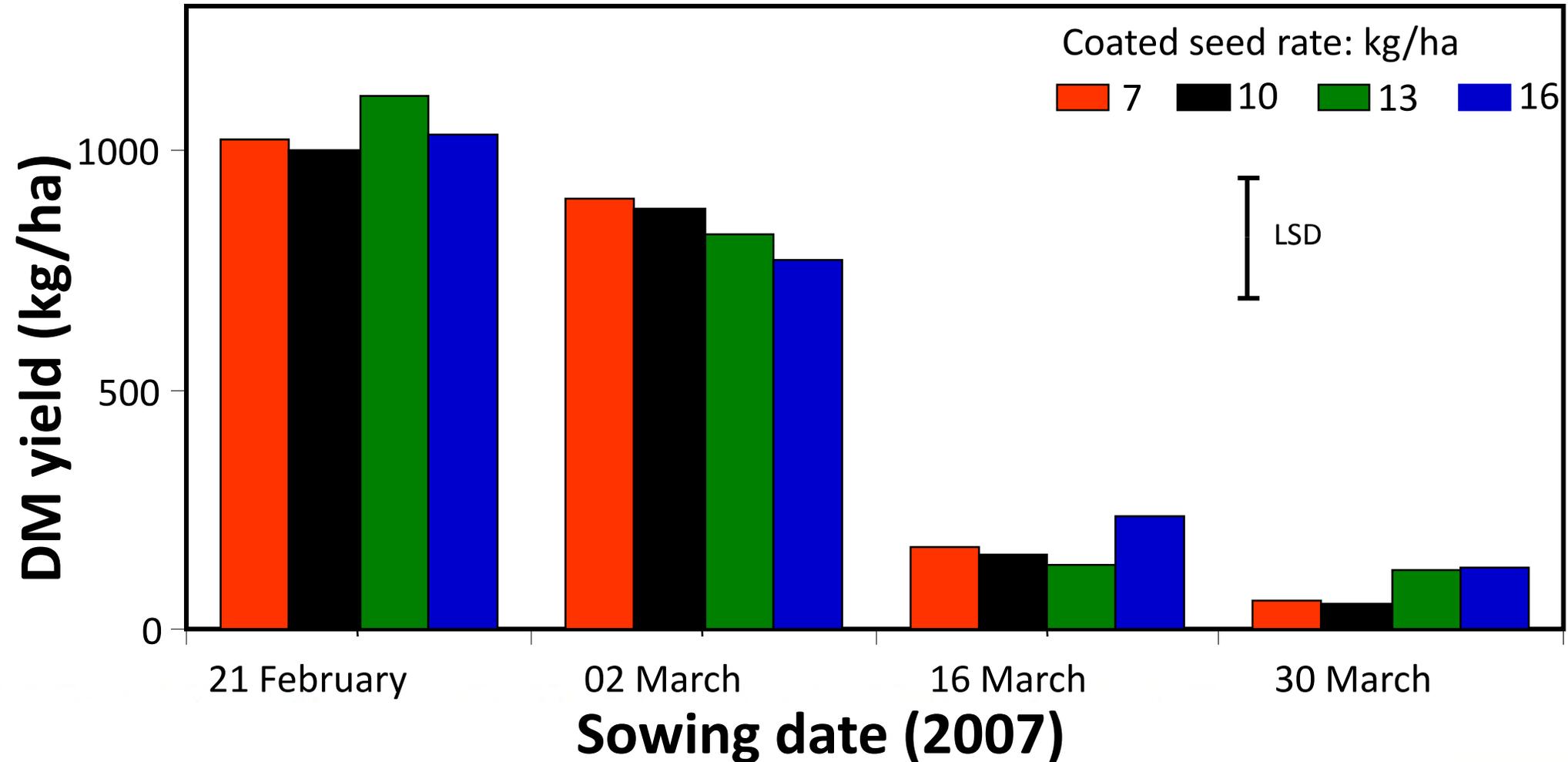
Four sowing rates

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

Sown seed & plant population over time



Seedling lucerne yield to early June



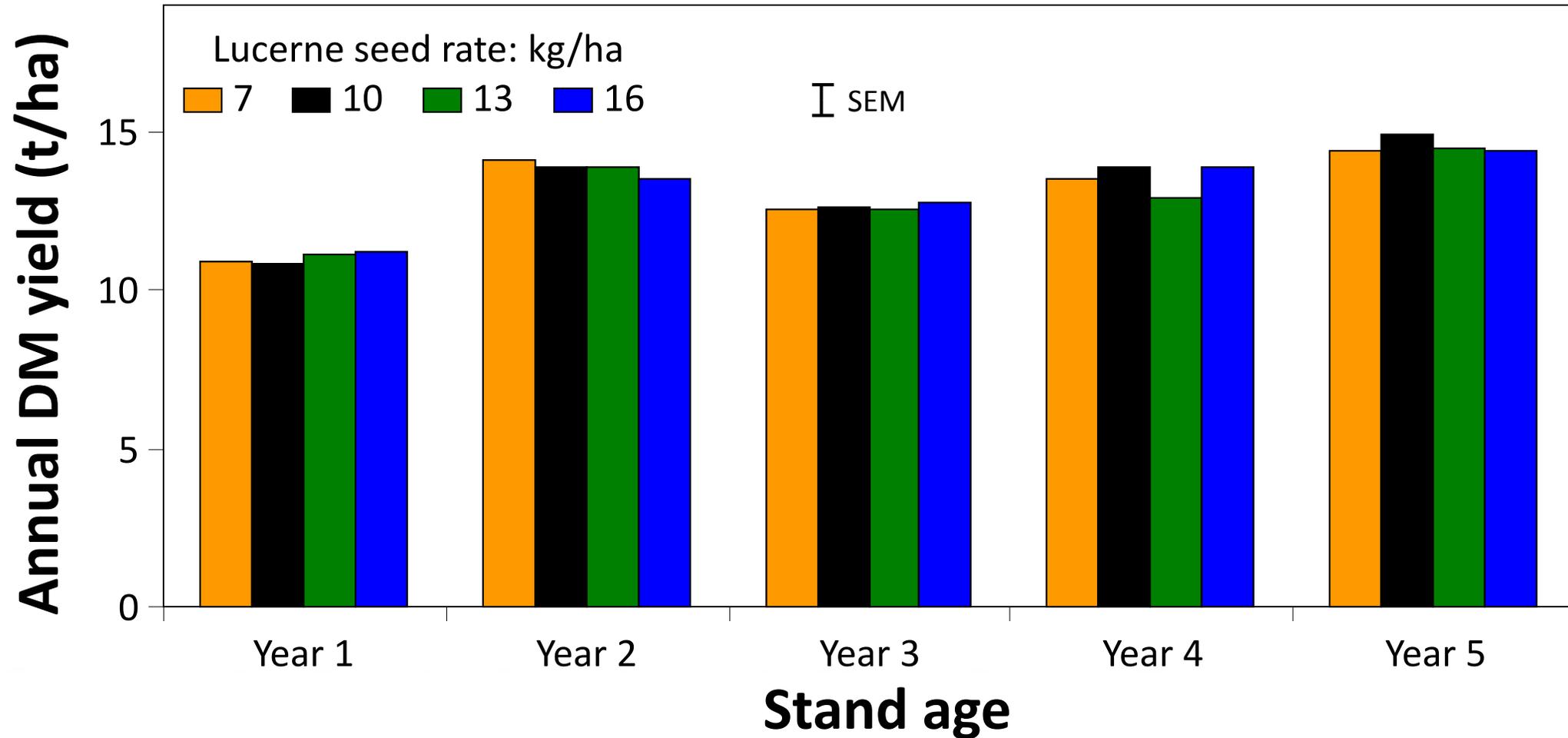
Weeds present @ 09 October 2007 (Year 1)



Sown 21 Feb 2007

Sown 30 Mar 2007

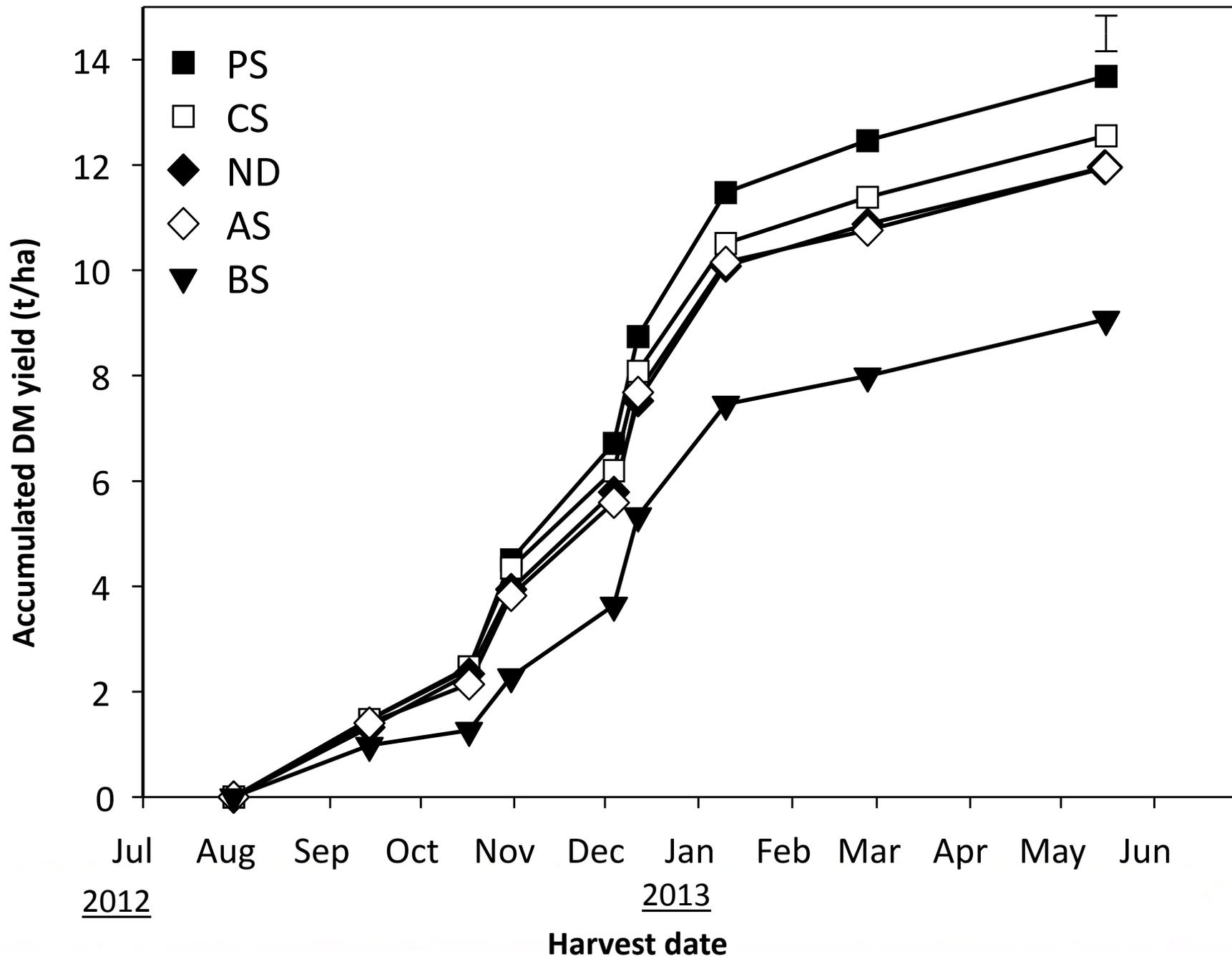
Annual yield in relation to sowing rate



Inoculation Experiment

- At Lincoln University
- Dryland, variable silt loam soil
- No history of lucerne
- Split plot design with 3 replicates
- 4 sowing dates
- 4 seed inoculant technologies used
- Bare seed control also used (no rhizobia)

New Zealand's specialist land-based university



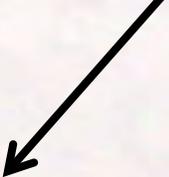
No inoculant (bare seed)



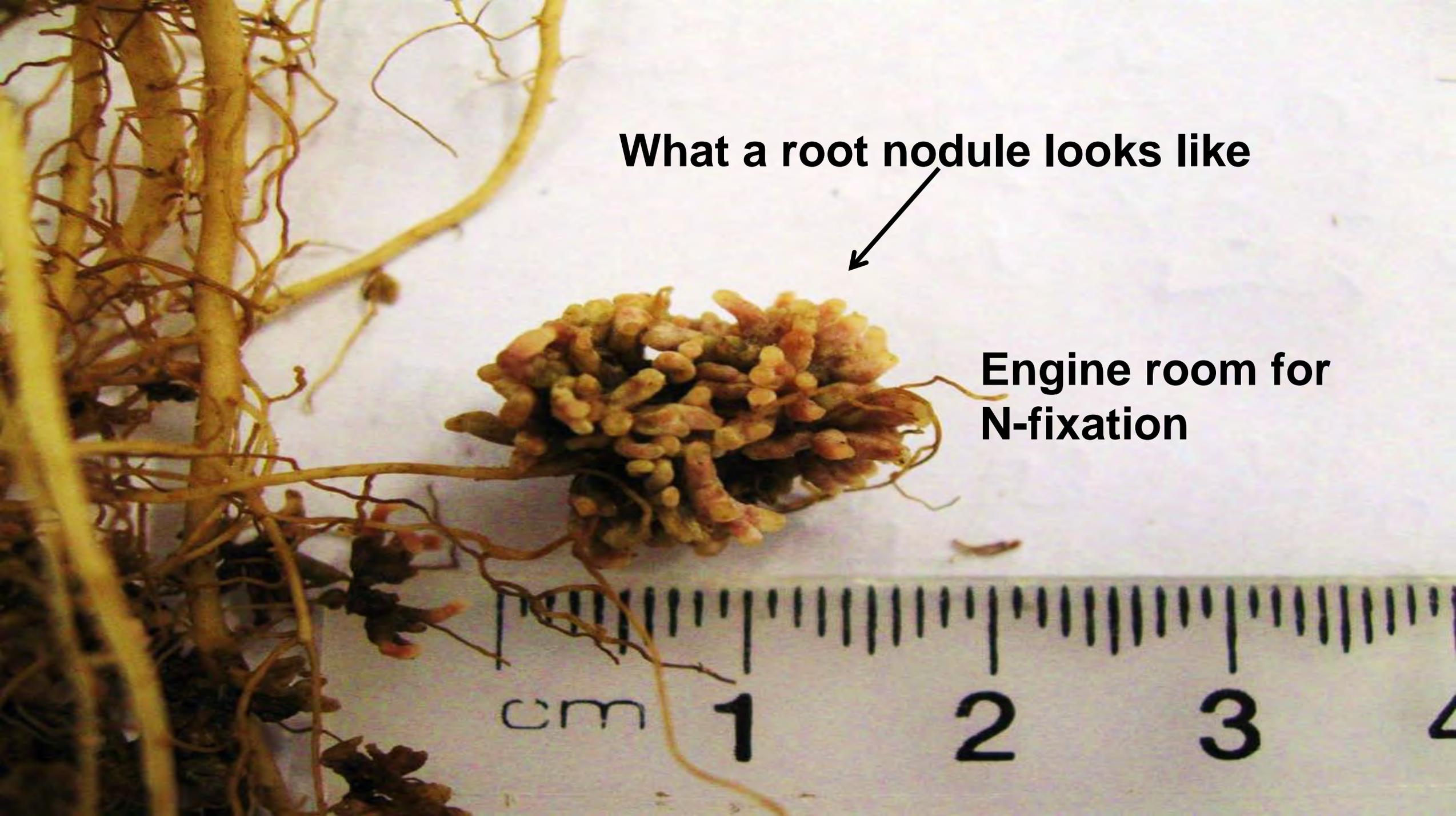
Inoculated with peat



What a root nodule looks like



**Engine room for
N-fixation**



Richard Sim PhD results

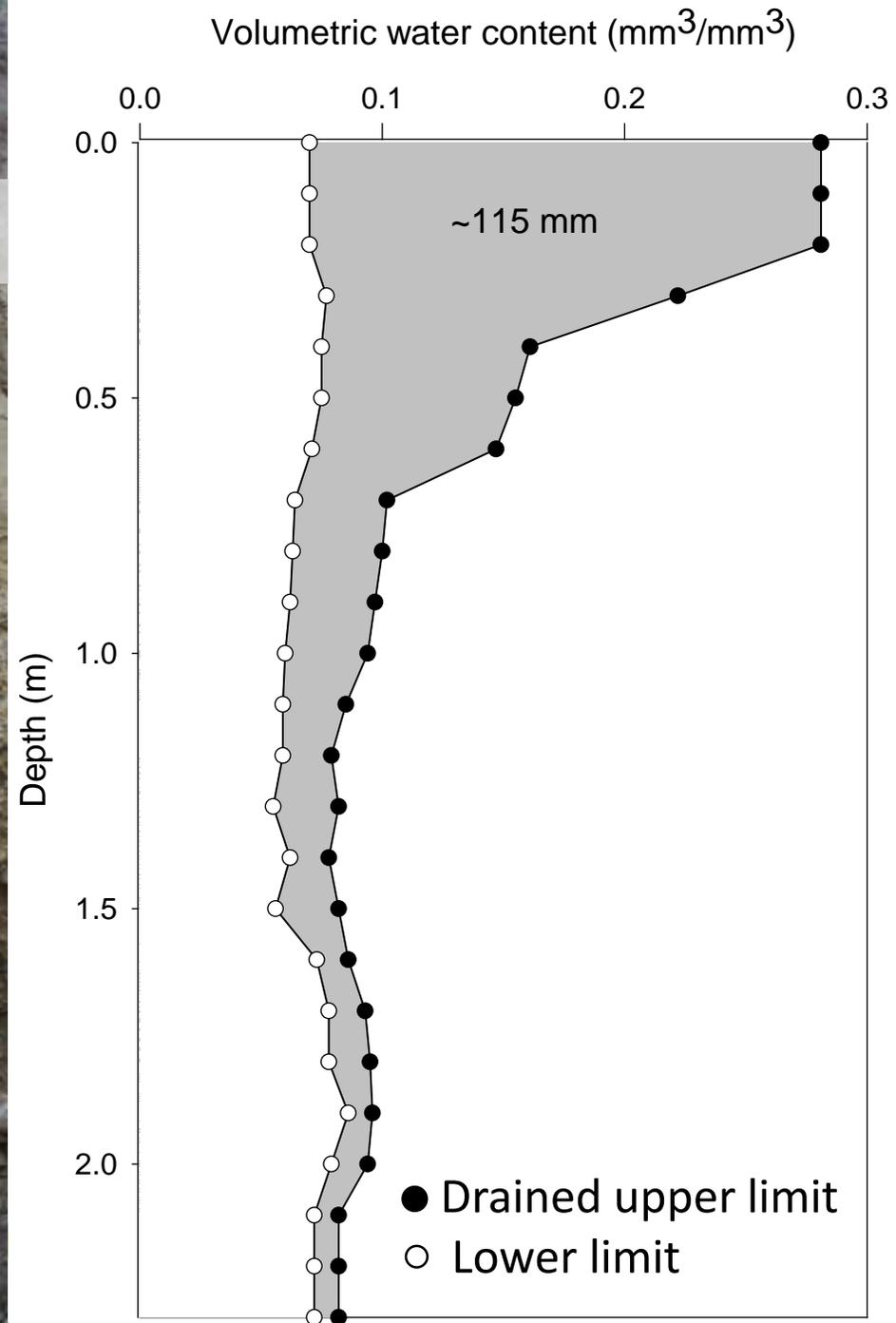
1. Soil type & sowing date
 2. Seedling vs regrowth crops (yr 2)
- Low soil water at Ashley Dene on stones
 - High soil water at LU on silt!

New Zealand's specialist land-based university

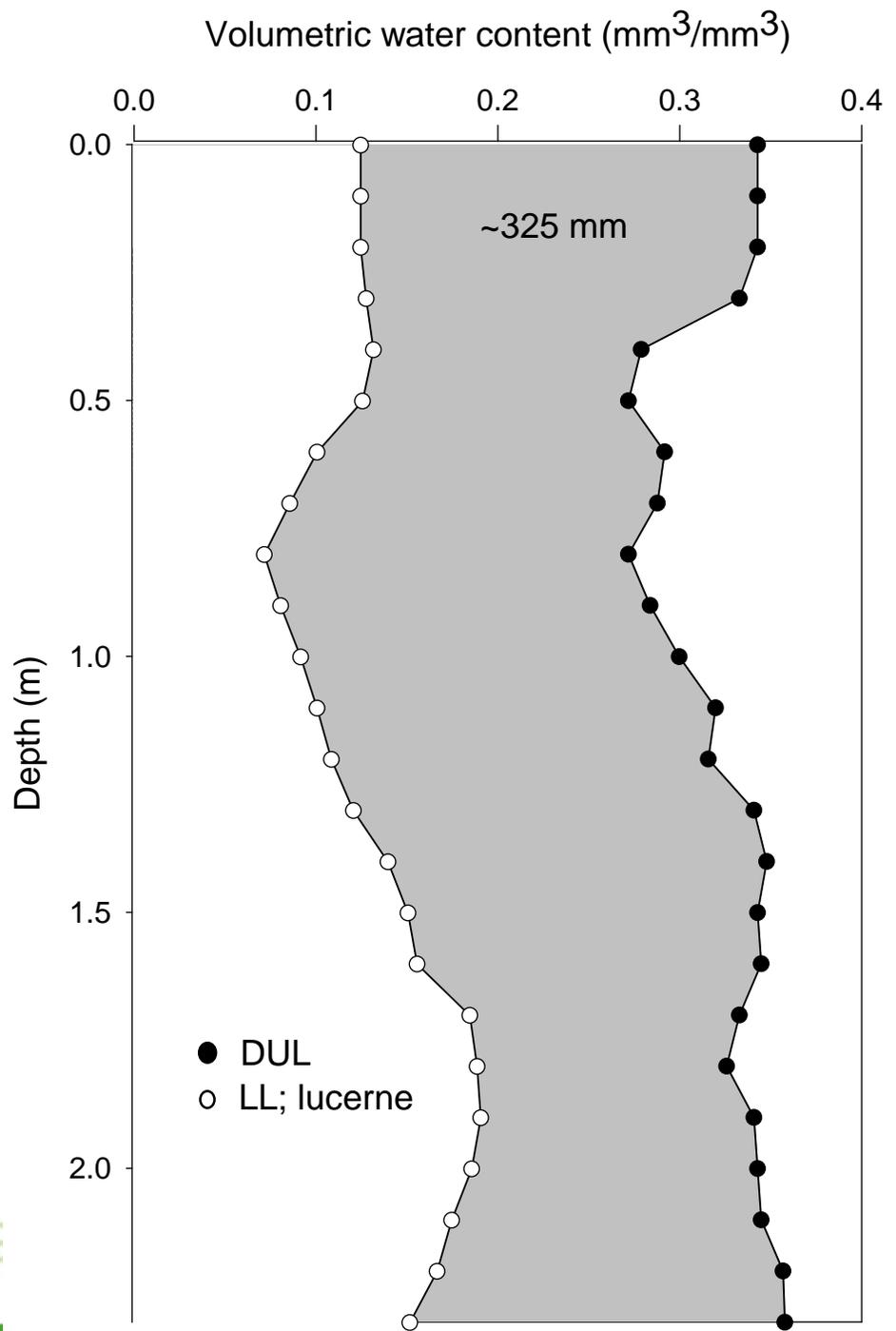
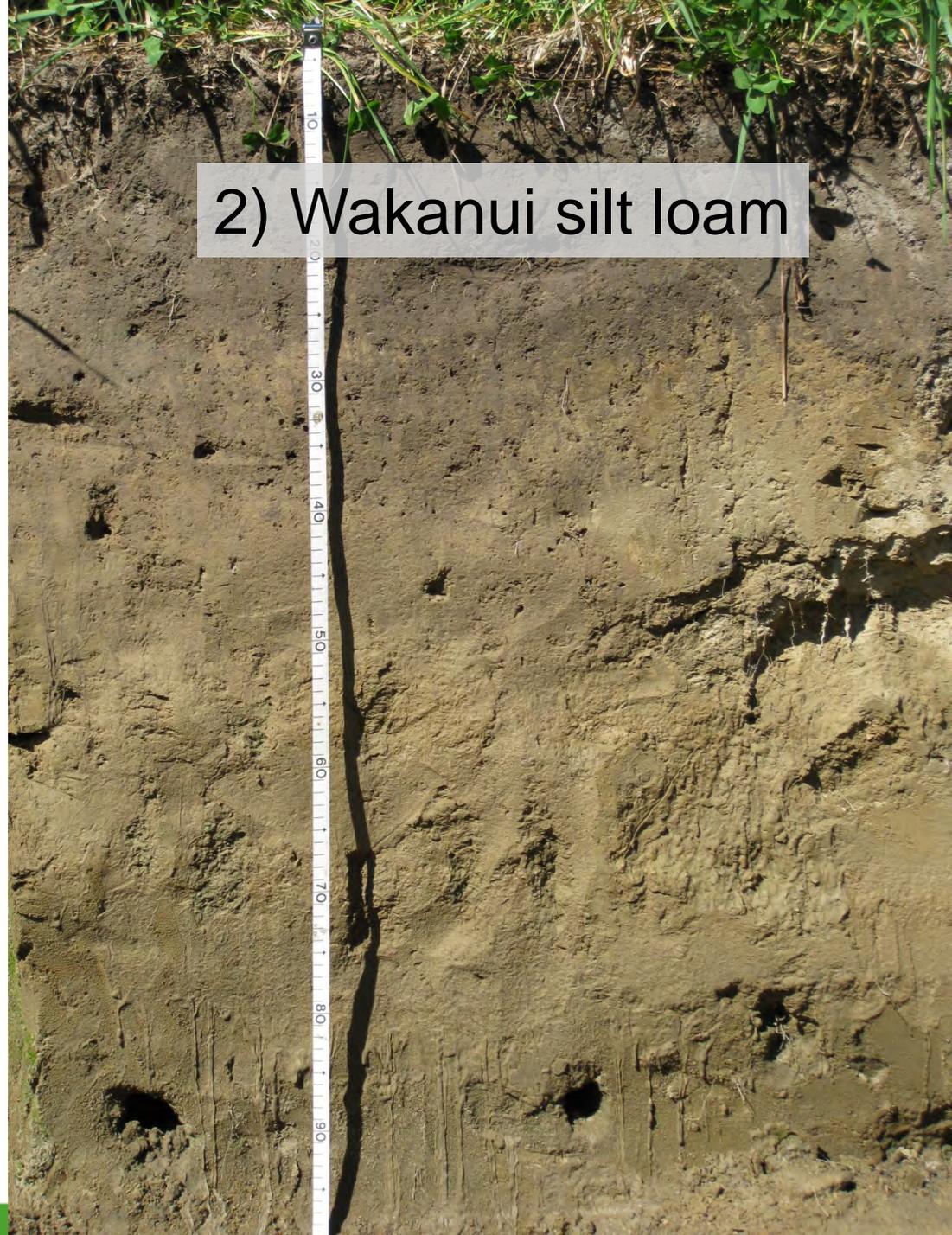


Ashley Dene, January 2012

1) Lismore stony silt loam



2) Wakanui silt loam

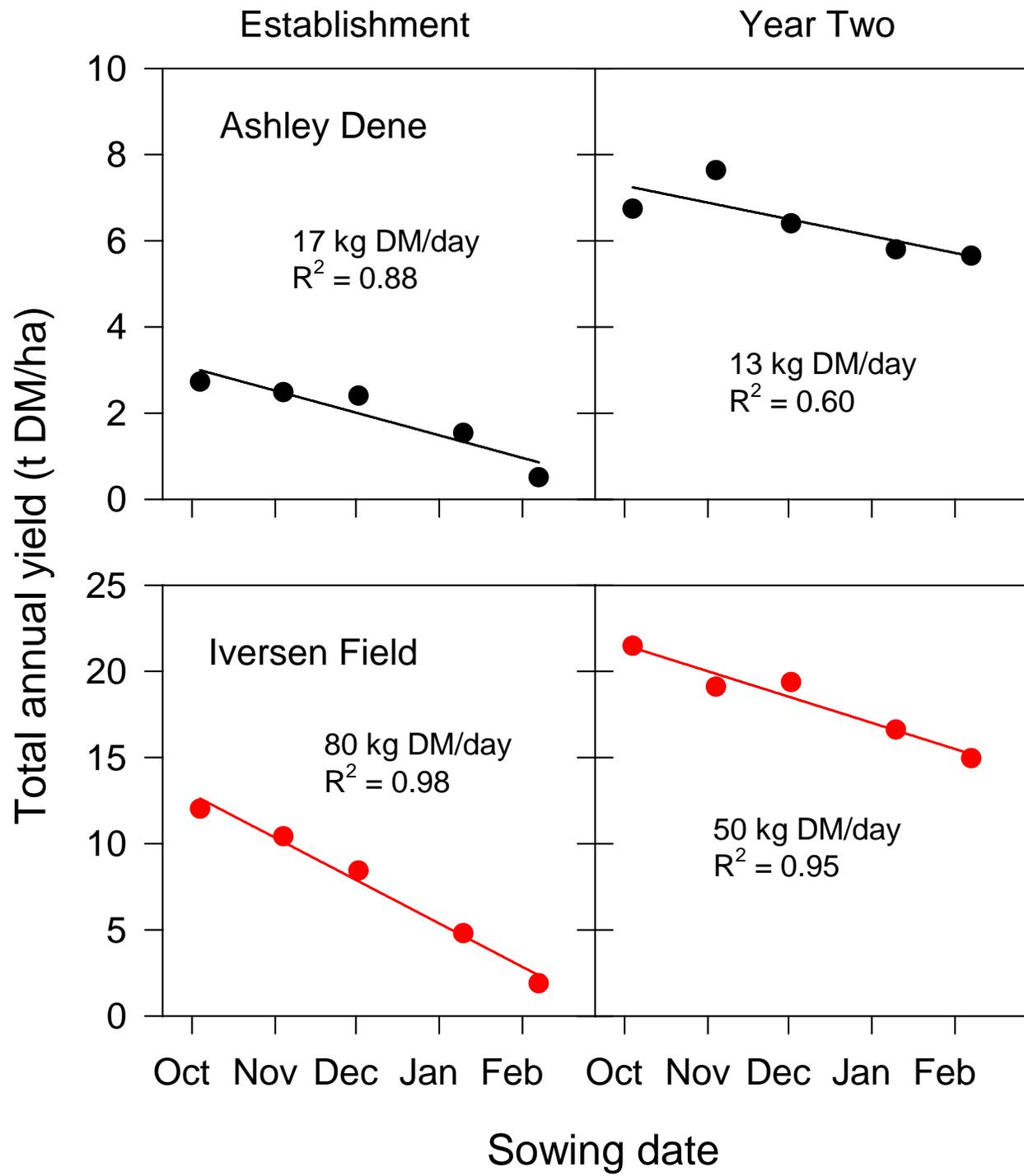




Seedling

Regrowth (year 2)

Iversen 12, January 2012



Delayed sowing cost yield

Sown: February ~ October



Sampled: June

Taproot mass

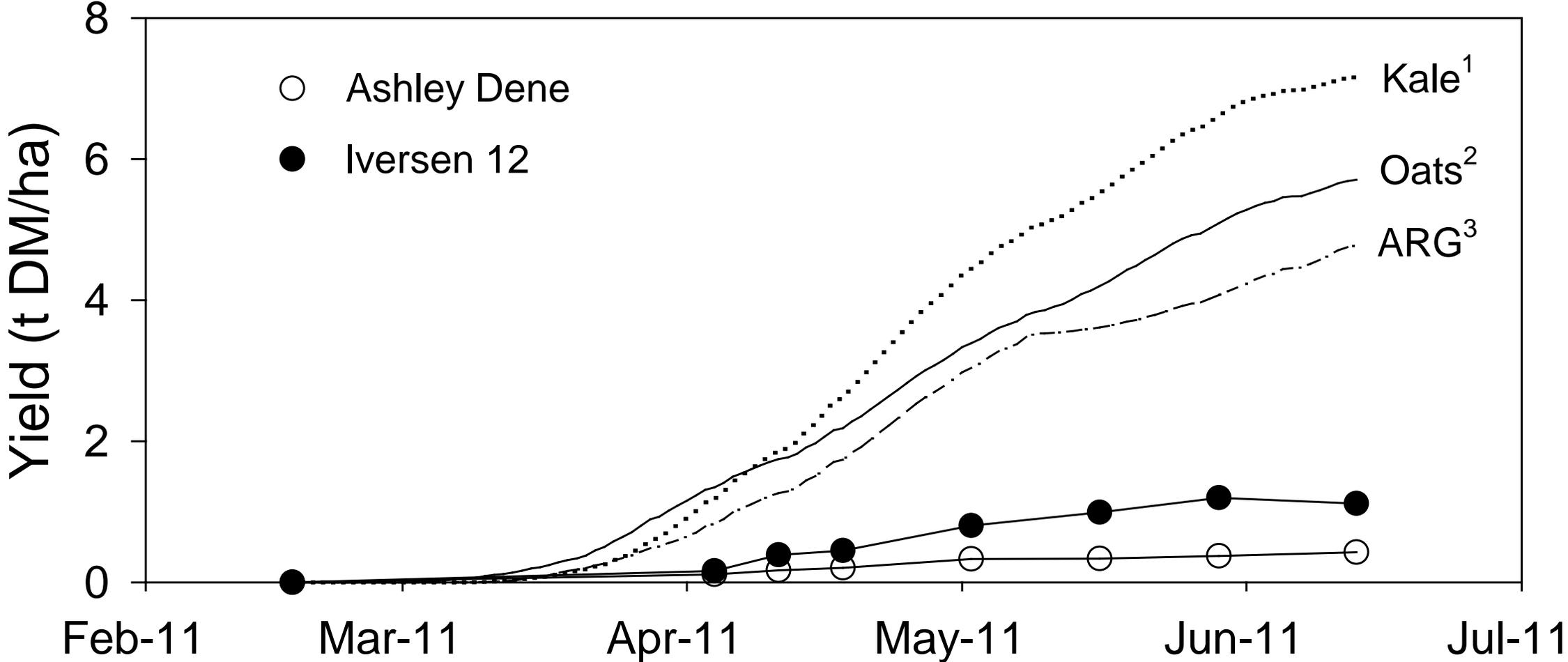
Taproot mass – Iversen 12

Sowing date	Root mass (t DM/ha)		
	Establishment	Year Two	Shoot+root (Year 2)
October	5.3 _b	6.7 _a	21.9
November	5.7 _a	6.6 _a	20.0
December	4.9 _{ab}	6.6 _a	21.2
January	3.2 _c	6.9 _a	20.3
February	1.1 _d	5.7 _b	19.5
P	<0.001	<0.05	
SEM	0.30	0.23	

Taproot mass – Ashley Dene

Sowing date	Root mass (t DM/ha)		
	Establishment	Year Two	Shoot+root (Year 2)
October	2.2 _a	4.8 _a	9.3
November	2.0 _a	4.6 _{ab}	9.2
December	1.6 _{ab}	4.0 _b	8.2
January	1.2 _b	3.5 _b	8.1
February	0.6 _c	3.4 _b	8.5
P	<0.001	<0.05	
SEM	0.19	0.24	

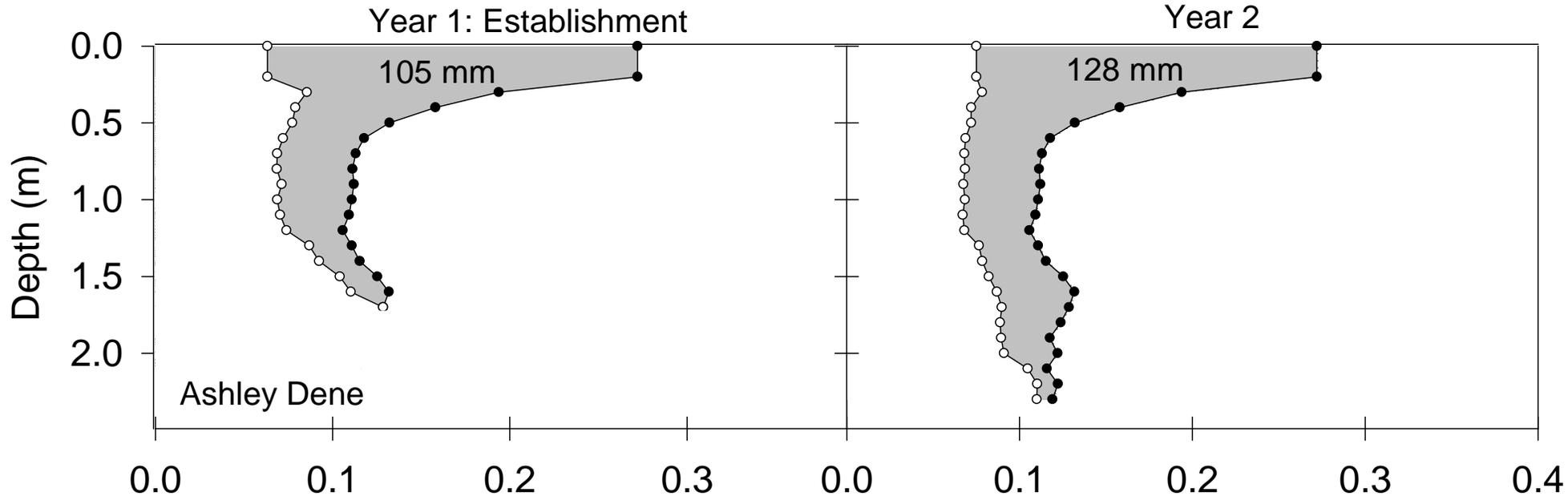
Potential yield of alternative crops



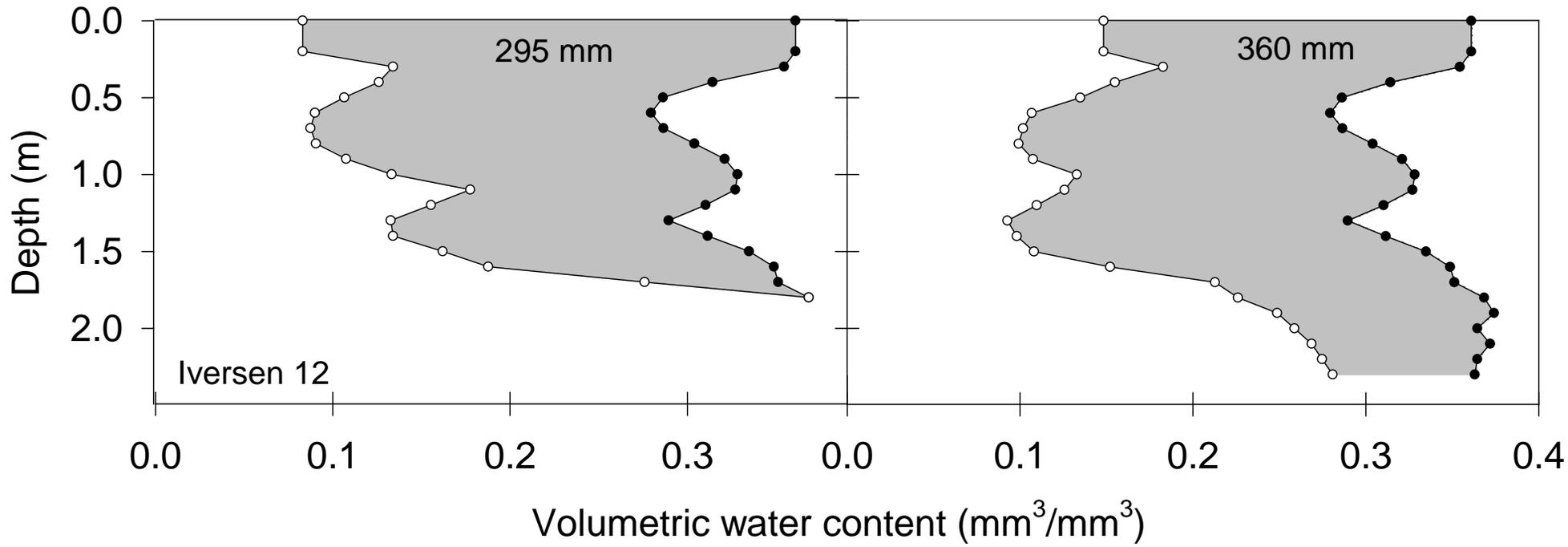
¹ Chakwizira (2008), Chakwizira *et al.*, (2011); ² Martini *et al.*, (2009); ³ Martini, (2012)

Water extraction – understanding yield

- Neutron probe (2.3 m)
- Seedling vs. regrowth lucerne
- The influence of soil type



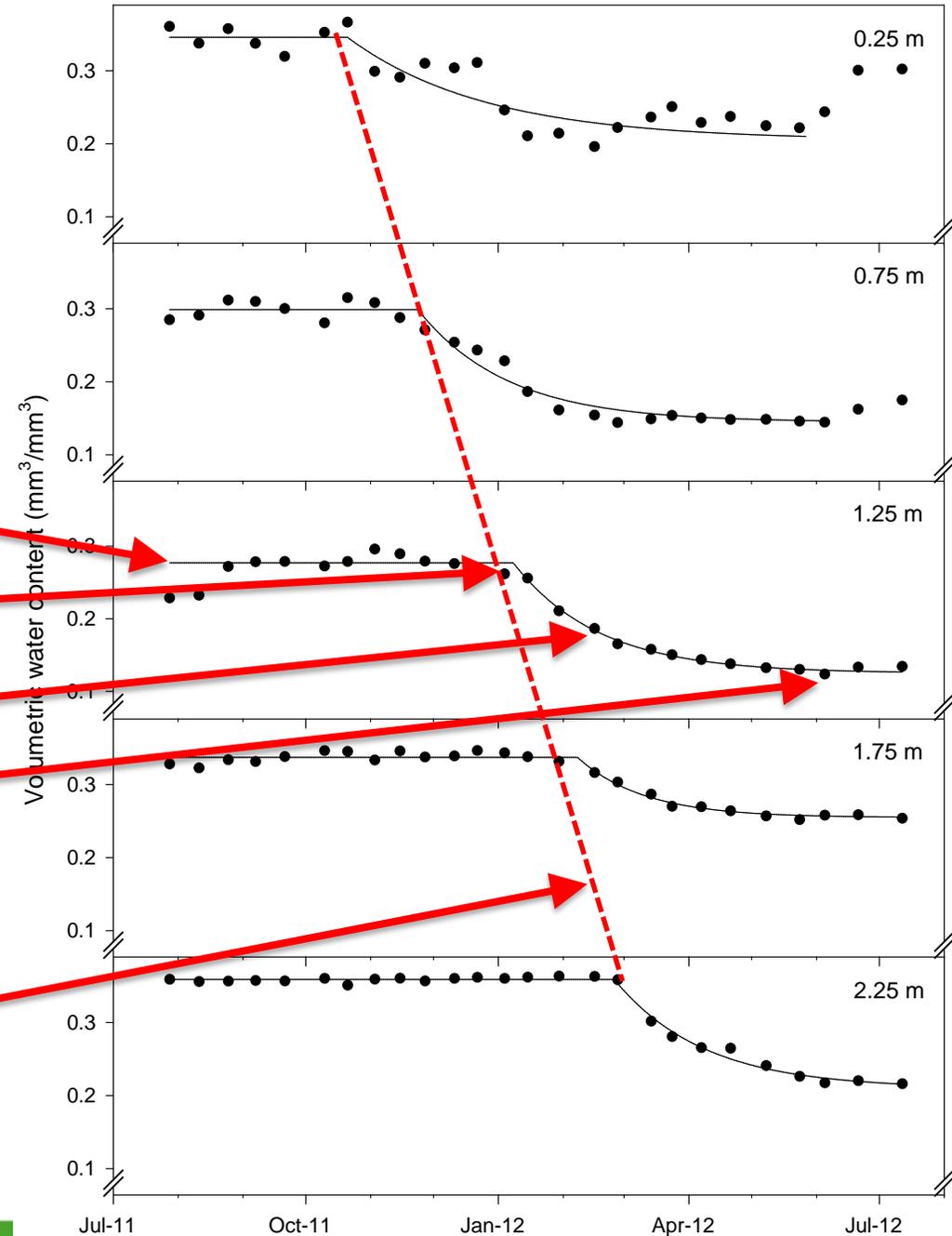
Water extraction



Water extraction

Extraction front velocity

Field capacity
Start of extraction
Rate of extraction
Lower limit





Ashley Dene



Iversen 12

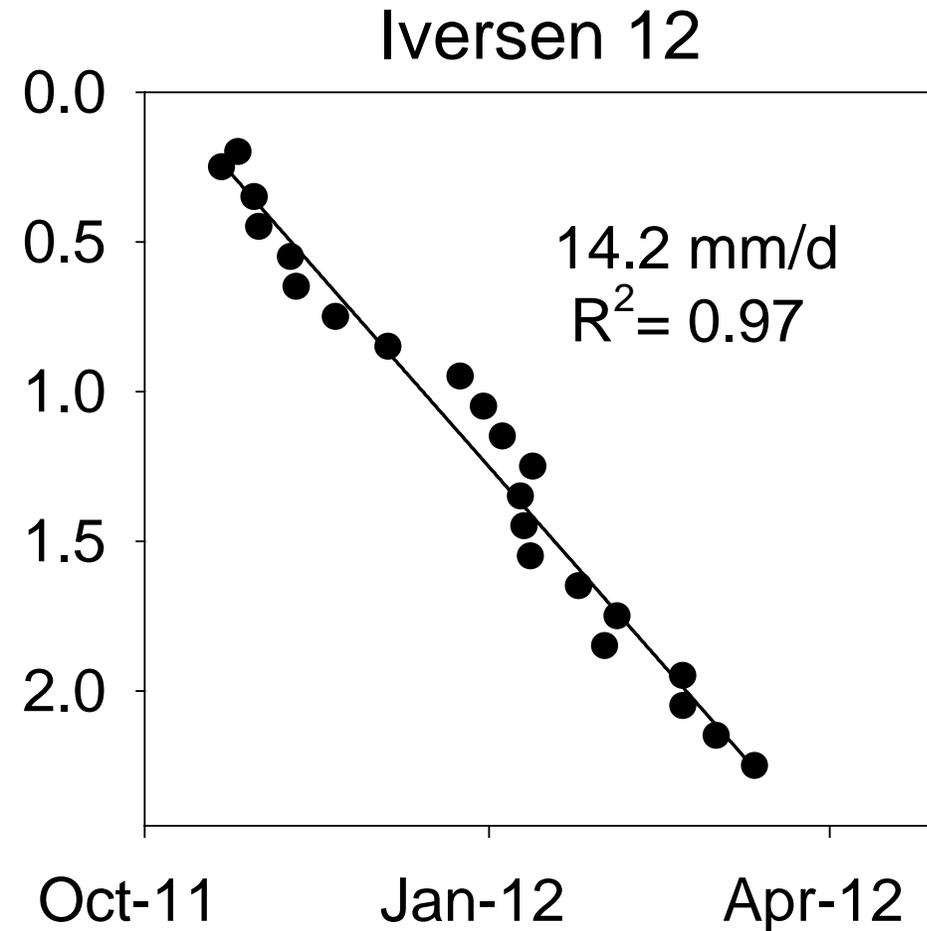
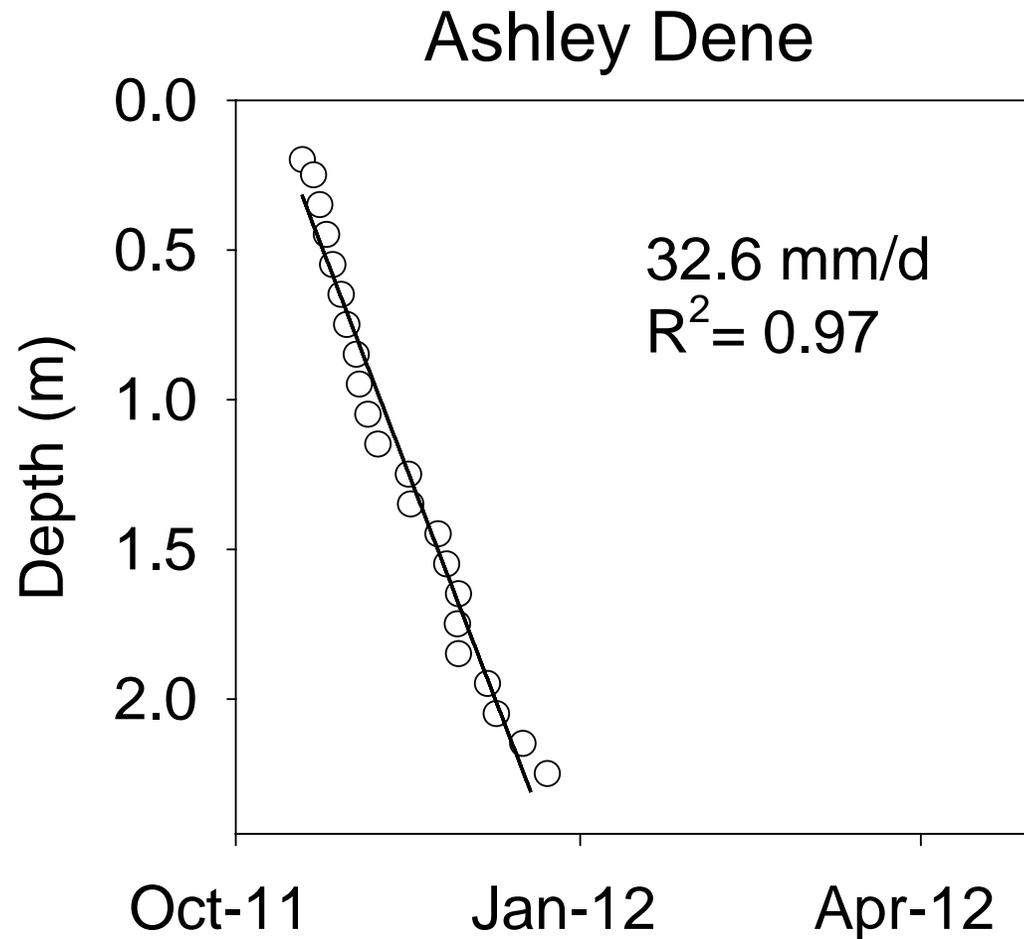
2nd Trifoliolate leaf

6th Trifoliolate leaf

	Shoot DW (mg)	Root DW (mg)	Shoot DW (mg)	Root DW (mg)
Ashley Dene	15.0 _b	3.7 _b	53.4 _b	15.6 _b
Iversen 12	25.3 _a	4.6 _a	117.4 _a	23.6 _a
P	<0.001	<0.001	<0.001	<0.05
SEM	0.82	0.24	8.37	2.23



Extraction front velocity – Year 2



Ashley Dene, January 2012



Feed supply

- Regrowth vs seedling crops
 - Sowing window: Oct-Dec
- First grazing in 3 months (50% flowering)

Conclusions from establishment

- Spring sow or grow a forage crop
- Yield in year one is lower due to partitioning
- Plant population self thins over time
- Inoculation is important in new sites
- Sow on deep soils
- Regrowth crops on shallow soils use soil water quickly
- Spread feed supply by new sowings each year

Lucerne grazing options

- **Rotational grazing**
- **Set stocking**
- **Grass mixes**

Pastoral 21 BLNZ funded programme

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

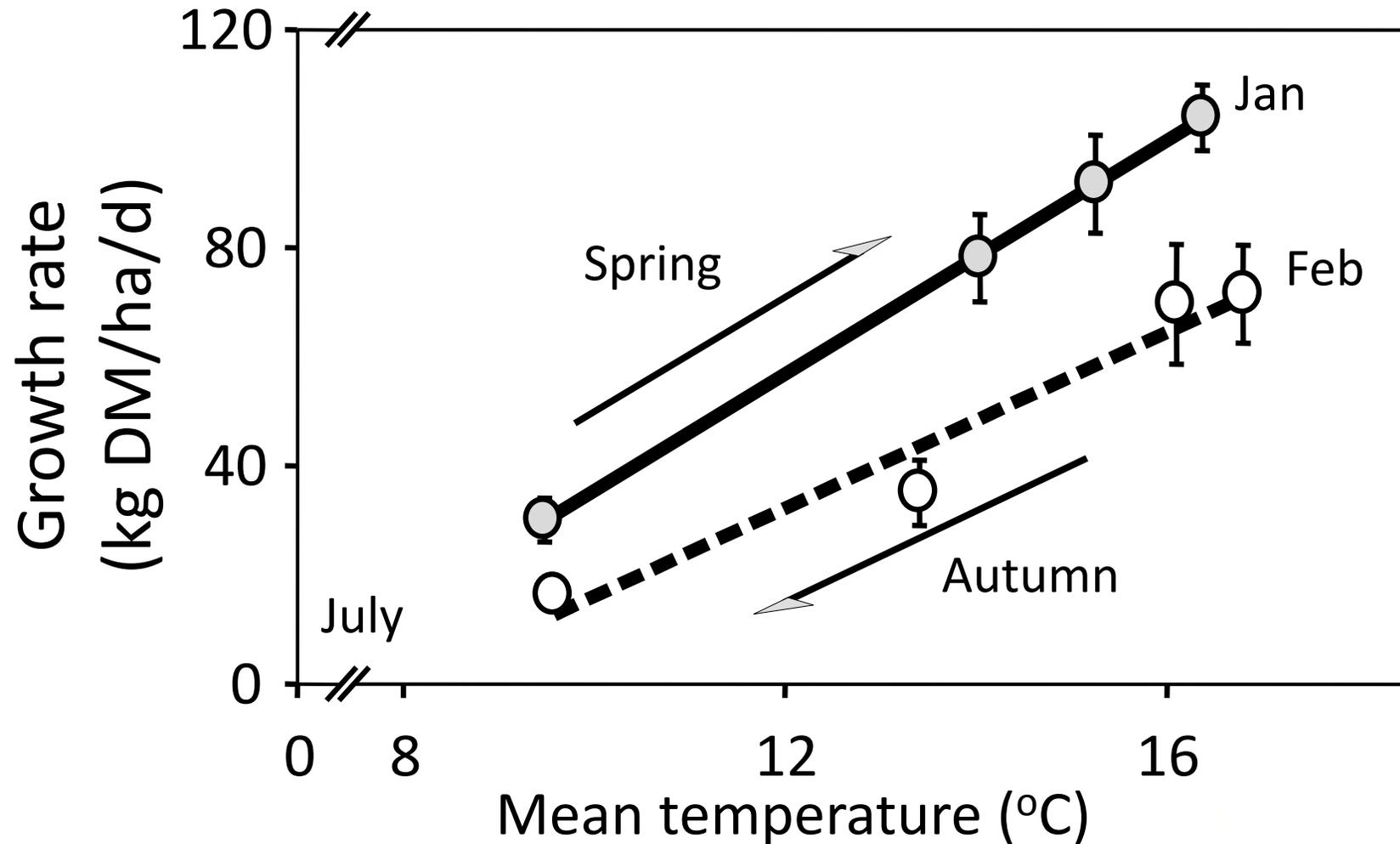
Growth and development are both influenced by environmental signals

New Zealand's specialist land-based university

The canopy: the energy capture device



Vegetative growth



Experiment 2

flexible grazing

38 days resting

4 days grazing

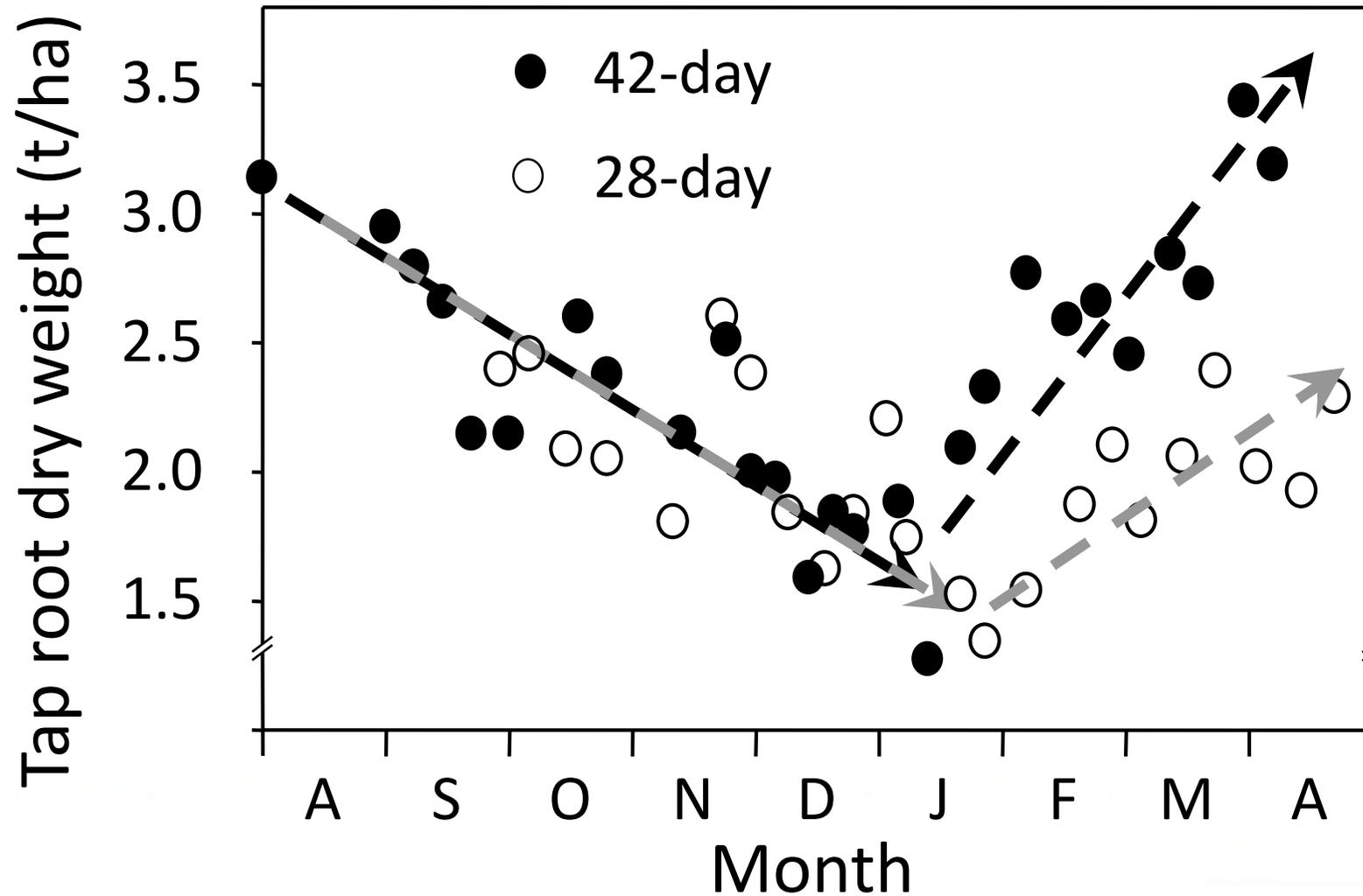


25 days resting

3 days grazing



Partitioning to roots



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

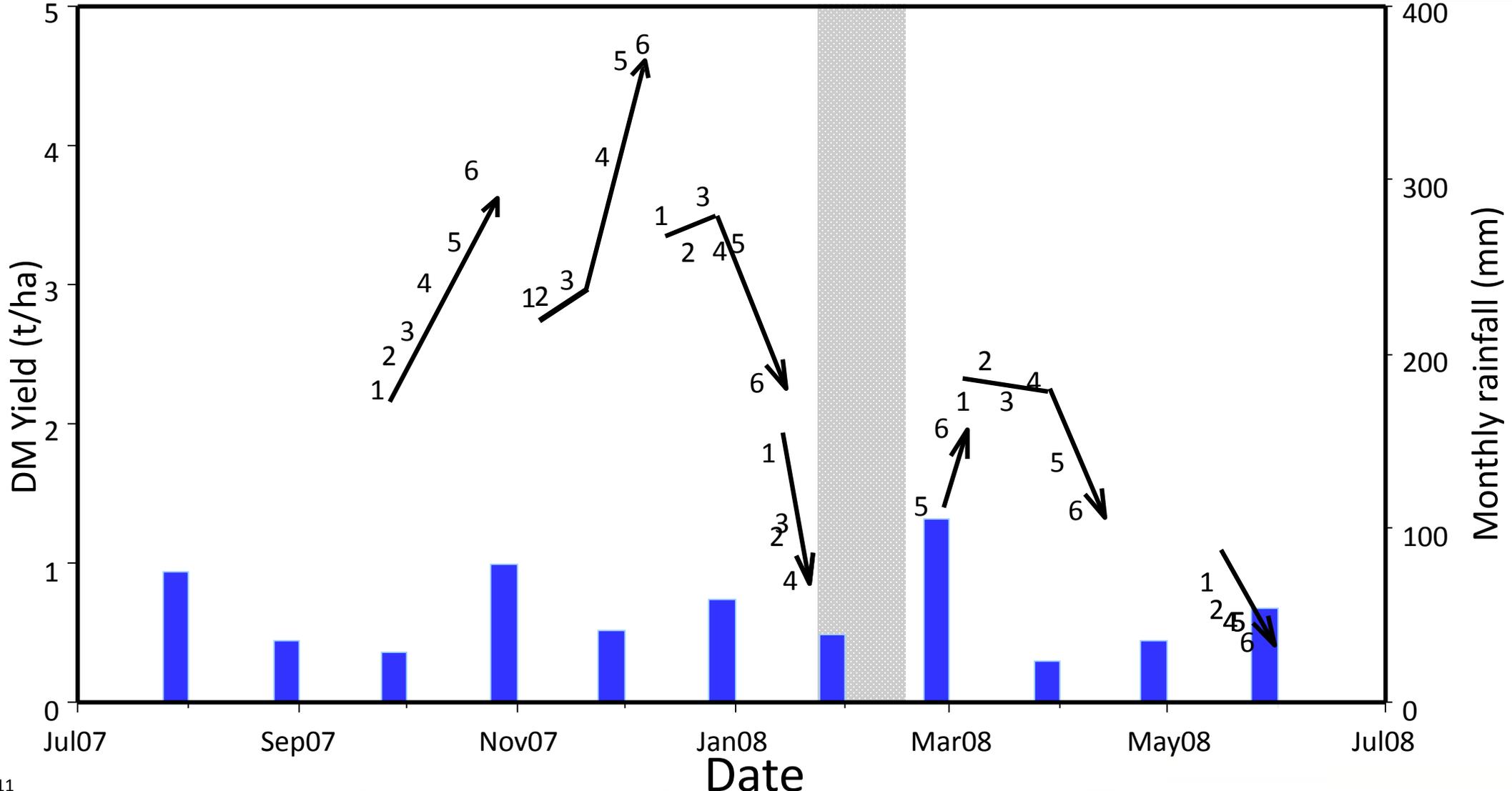
Growing point at the top of the plant

New Zealand's specialist land-based university



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





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

New Zealand's specialist land-based university



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

New Zealand's specialist land-based university



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**

New Zealand's specialist land-based university

**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

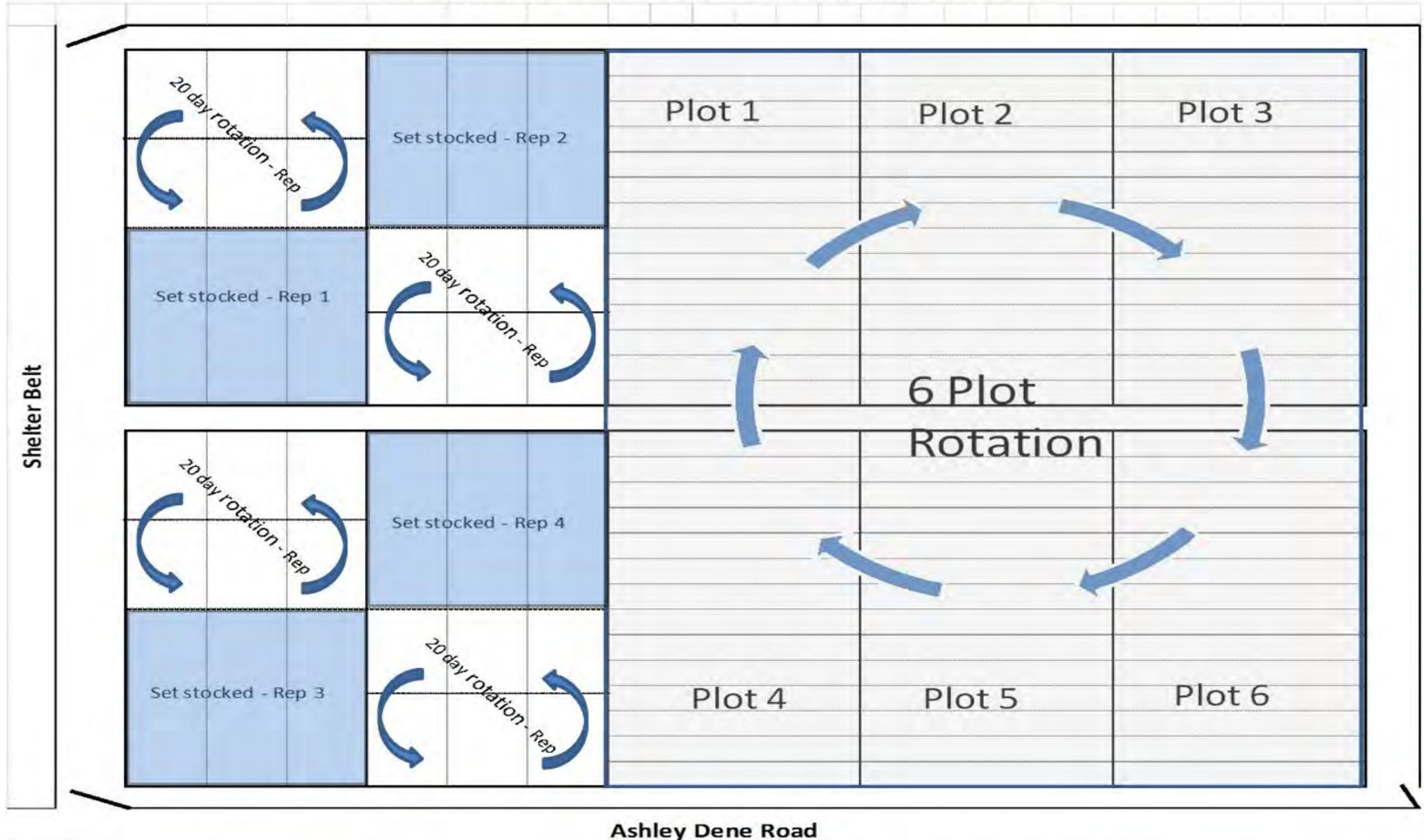
Objective

- Evaluate three spring grazing management strategies for lucerne monocultures
 - Rotational grazing (6 paddock system)
 - Set stocked (SS) until weaning
 - Semi set stocked (SSS) until weaning (10 day shifts)
- After weaning SS and SSS lambs mobbed up and moved to an 8 paddock rotational grazing system (RECOVERY PHASE)

Contributes to: Critical measures A & B

New Zealand's specialist land-based university

Ashley Dene Lucerne - H7 - Grazing Treatments

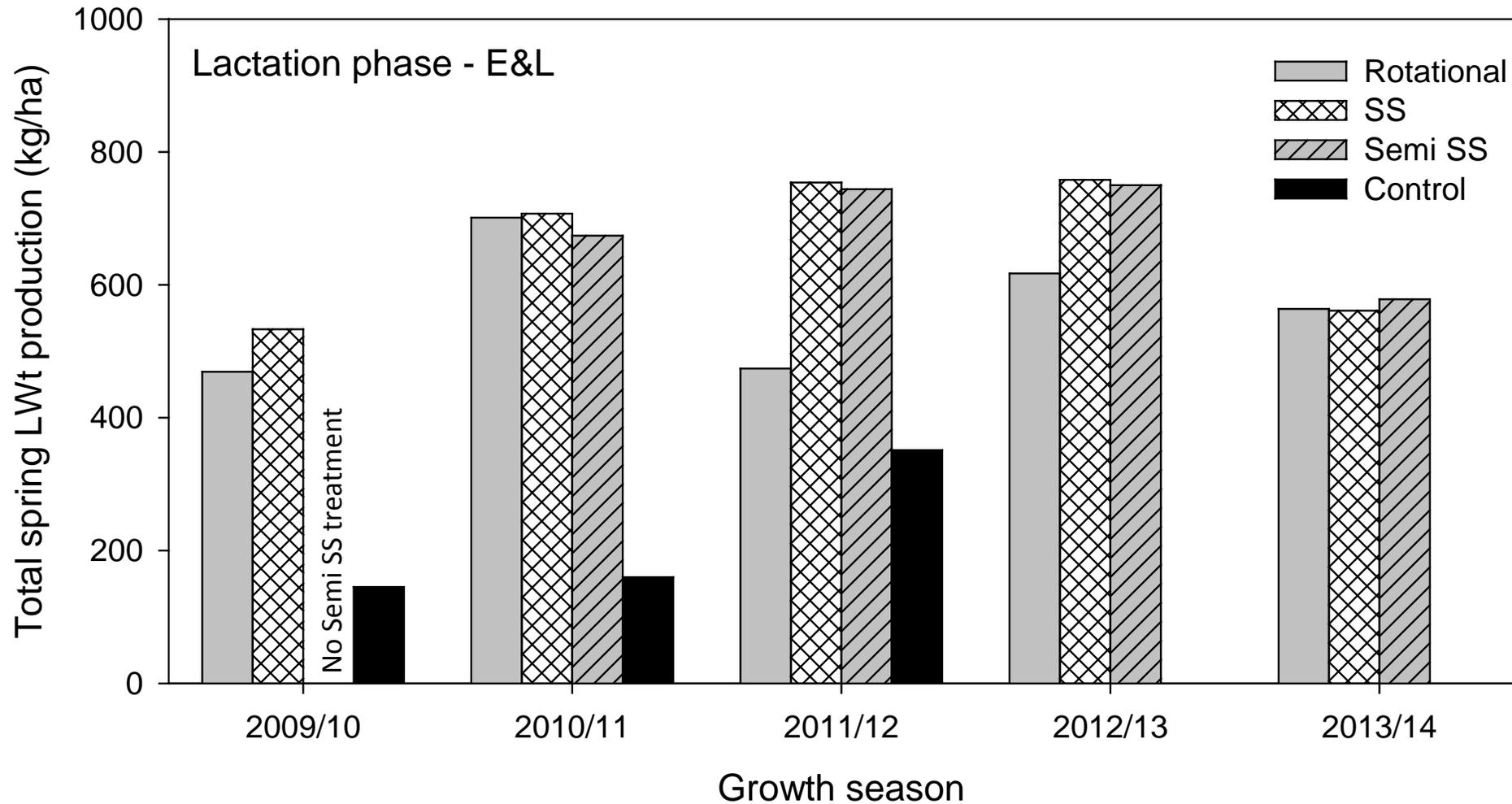


Project 3 – Spring grazing management of lucerne

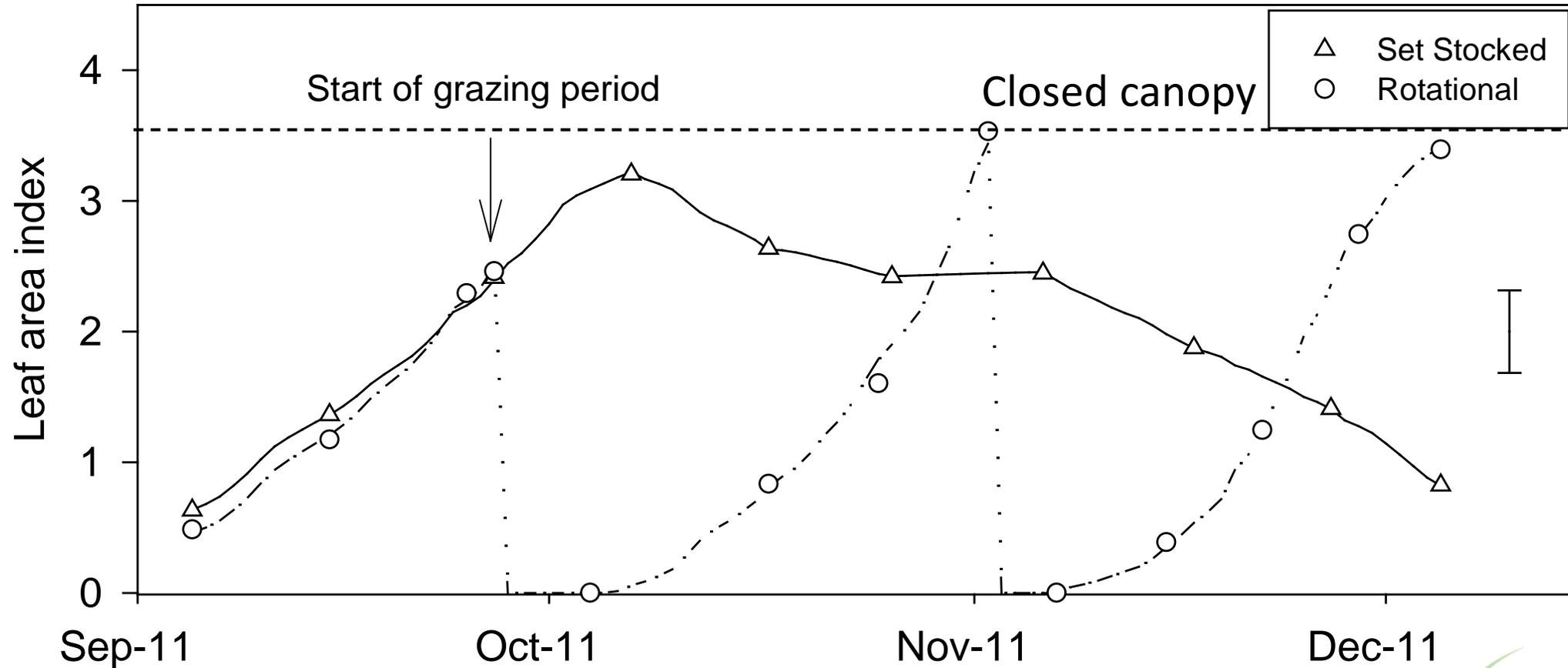
23/9/2010



Total LWt produced



Crop canopy



New Zealand's specialist land-based university

RULES FOR SET STOCKING LUCERNE

1. Manage lucerne pure swards first.
2. Choose paddocks to lamb on early in autumn – shelter, older, early clean-up graze and winter herbicide application.
3. Lucerne grass mixes – grass transition.
4. Early and late for condensed lambing (1 cycle).
5. Drift onto lucerne ~14 d prior to lambing
6. Lucerne ~20 cm tall and keep it there.

RULES FOR SET STOCKING cont'd.

7. Stock at about half the rotational grazing rate
8. SS for 4-5 weeks – then rotate
9. SS lambs use the taller feed as shelter.
10. Stocking rate to keep closed canopy!
11. Canopy gets taller over 4-5 weeks not shorter
12. Once canopy reduces begin rotational grazing
13. Open canopy = twitch, yarrow, dandelions.
14. Paddocks need autumn (6 wks) recharge.

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).

Ates, S., Tongel, M. O. and Moot, D. J. 2010. Annual herbage production increased 40% when subterranean clover was over-drilled into grass-dominant dryland pastures. *Proceedings of the New Zealand Grassland Association*, **72**, 3-9.

Black, D. B. S. and Moot, D. J. 2013. Autumn establishment of lucerne (*Medicago sativa* L.) inoculated with four different carriers of *Ensifer melloti* at four sowing dates. *Proceedings of the New Zealand Grassland Association*, **75**, 137-144.

Brown, H. E., Moot, D. J., Lucas, R. J. and Smith, M. 2006. Sub clover, cocksfoot and lucerne combine to improve dryland stock production. *Proceedings of the New Zealand Grassland Association*, **68**, 109-115.

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>.

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>. Cosgrove G. 2005. Novel grazing management: making better use of white clover. Proceedings of the 2005 SIDE Conference. Online: http://www.side.org.nz/IM_Custom/ContentStore/Assets/7/43/5084880571838b9ff7514c0efc22097d/Novel%20grazing%20management%20options.pdf

Costello, T. and Costello, A. 2003. Subterranean clover in North Canterbury sheep pastures. *In*. Legumes for dryland pastures. Proceedings of a New Zealand Grassland Association. Palmerston North New Zealand: New Zealand Grassland Association, 189-192.

Dumbleton, A.J. 1997. White clover and chicory production from four sowing dates with five rates of ryegrass. B.Ag.Sci (Hons) dissertation, Lincoln University, Canterbury. 85 pp.

Hurst, R. G. M., Black, A. D., Lucas, R. J. and Moot, D. J. 2000. Sowing strategies for slow-establishing pasture species on a North Otago Dairy farm. *Proceedings of the New Zealand Grassland Association*, **62**, 129-135.

New Zealand's specialist land-based university

References & Links (cont.)



- Kearney, J. K., Moot, D. J. and Pollock, K. M. 2010. Dryland lucerne production in Central Otago. *Proceedings of the New Zealand Grassland Association*, **72**, 121-126.
- 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., 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., Lucas, R. J. and Moot, D. J. 2014. '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.12130).
- 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).
- 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., 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>
- New Zealand Fertiliser Manufacturers' Research Association. 2011. Annual update (New Zealand Fertiliser Manufacturers' Research Association). 15 pp. Date Accessed: 5/5/2011. <http://www.fertresearch.org.nz/resource-centre/annual-updates>. Last Updated: Dec 2009.
- Nicholls, A. C. 1998. Second year yield and composition of pastures sown on our dates ith five rates of ryegrass., B.Ag.Sci(Hons) dissertation, Lincoln University, Lincoln. 89 pp.
- Sim, R.E. 2014. Water extraction and use of seedling and established dryland lucerne crops. Ph.D thesis, Lincoln University, Lincoln, Canterbury. 264 pp.
- Thomas, R. G. 2003. Comparative growth forms of dryland forage legumes. In. Legumes for dryland pastures. Proceedings of a New Zealand Grassland Association. Palmerston North New Zealand: New Zealand Grassland Association, 19-25.
- Widdup, K. H., Hussain, S. W., Williams, W. M., Lowther, W. L., Pryor, H. N. and Sutherland, B. L. 2003. The development and plant characteristics of interspecific hybrids between white and caucasian clover. In. Legumes for dryland pastures. Proceedings of a New Zealand Grassland Association. Palmerston North New Zealand: New Zealand Grassland Association, 143-148.