Living the Legume Vision

Ballance Altum, Rotorua
27 June 2012

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Professor of Plant Science

http://www.lincoln.ac.nz/dryland

Lincoln University
Te Whare Wānaka o Aoraki
CHRISTCHURCH·NEW ZEALAND

Experiment site

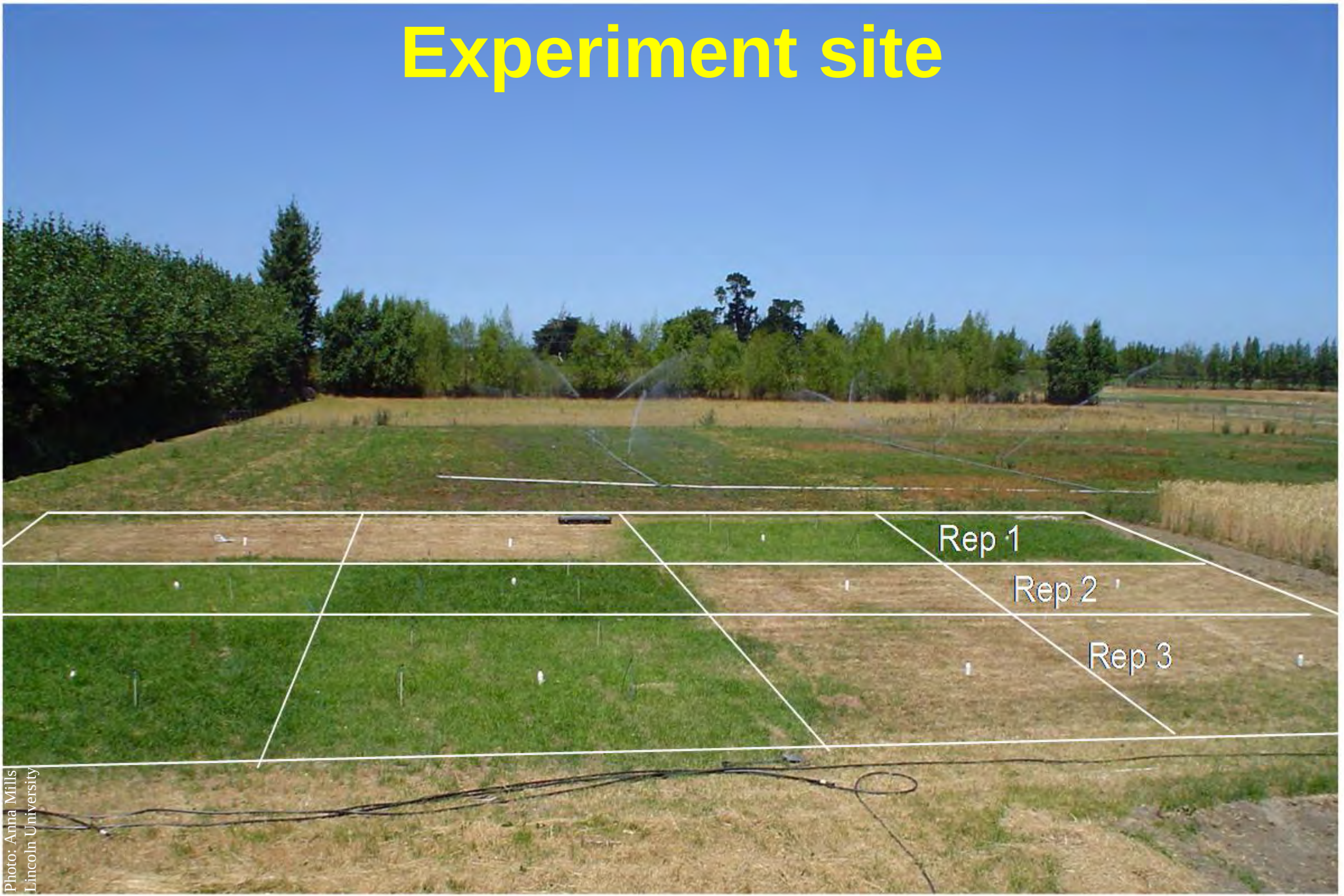
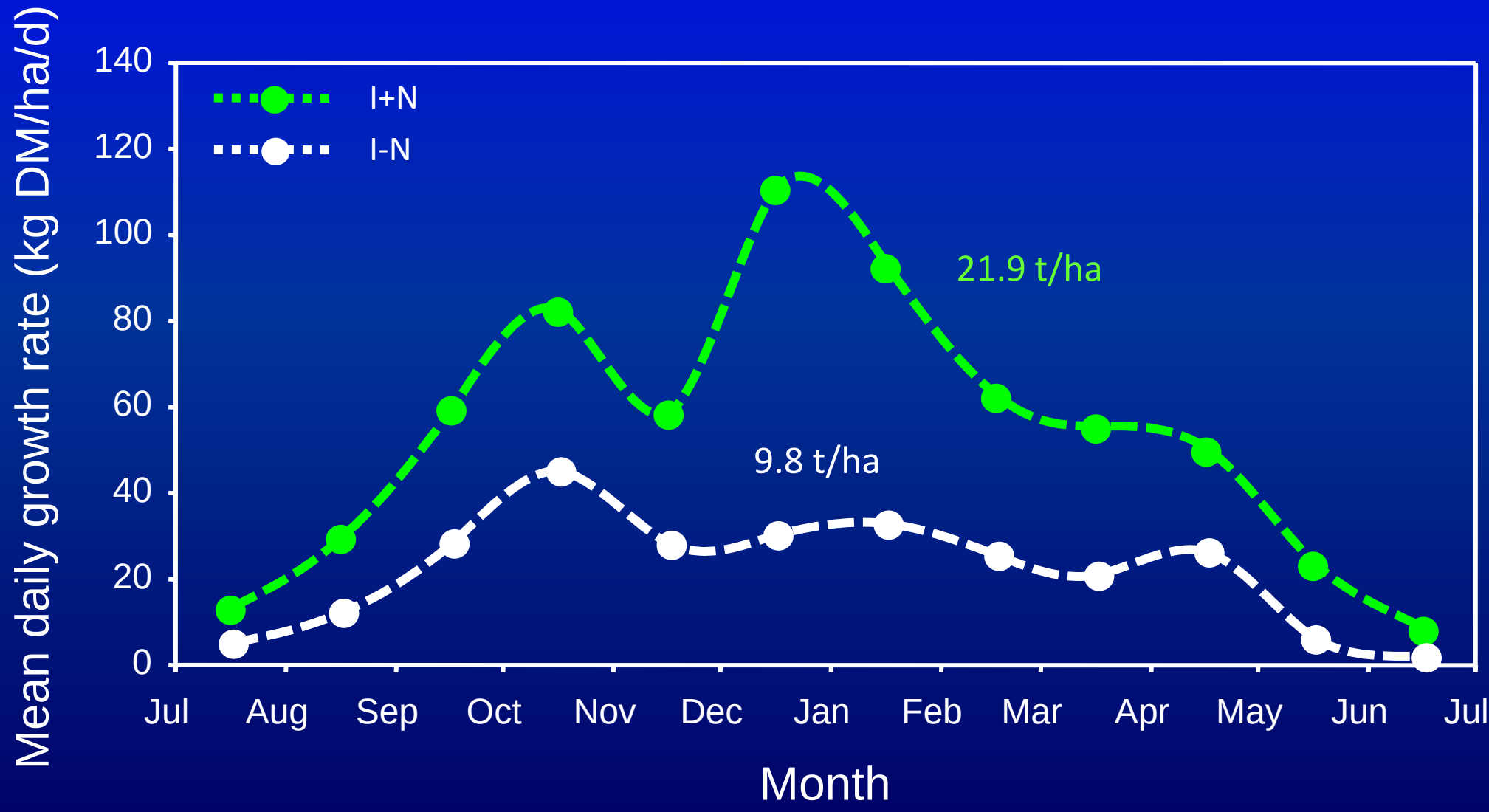


Photo: Anna Mills
Lincoln University

Pasture Growth Rates – 2 yr mean



Source: Mills *et al*. 2006

Winter ⇒ temperature response

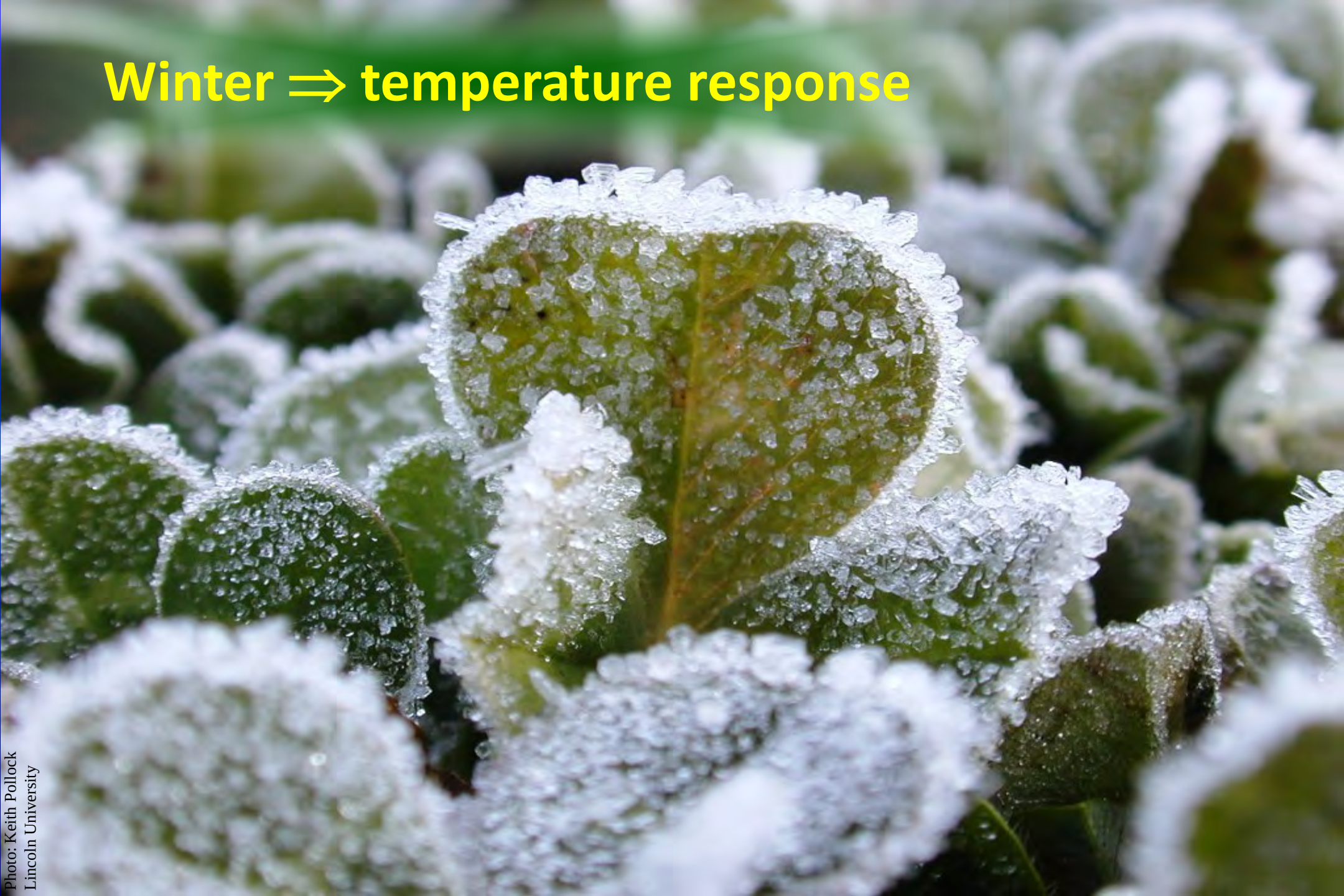
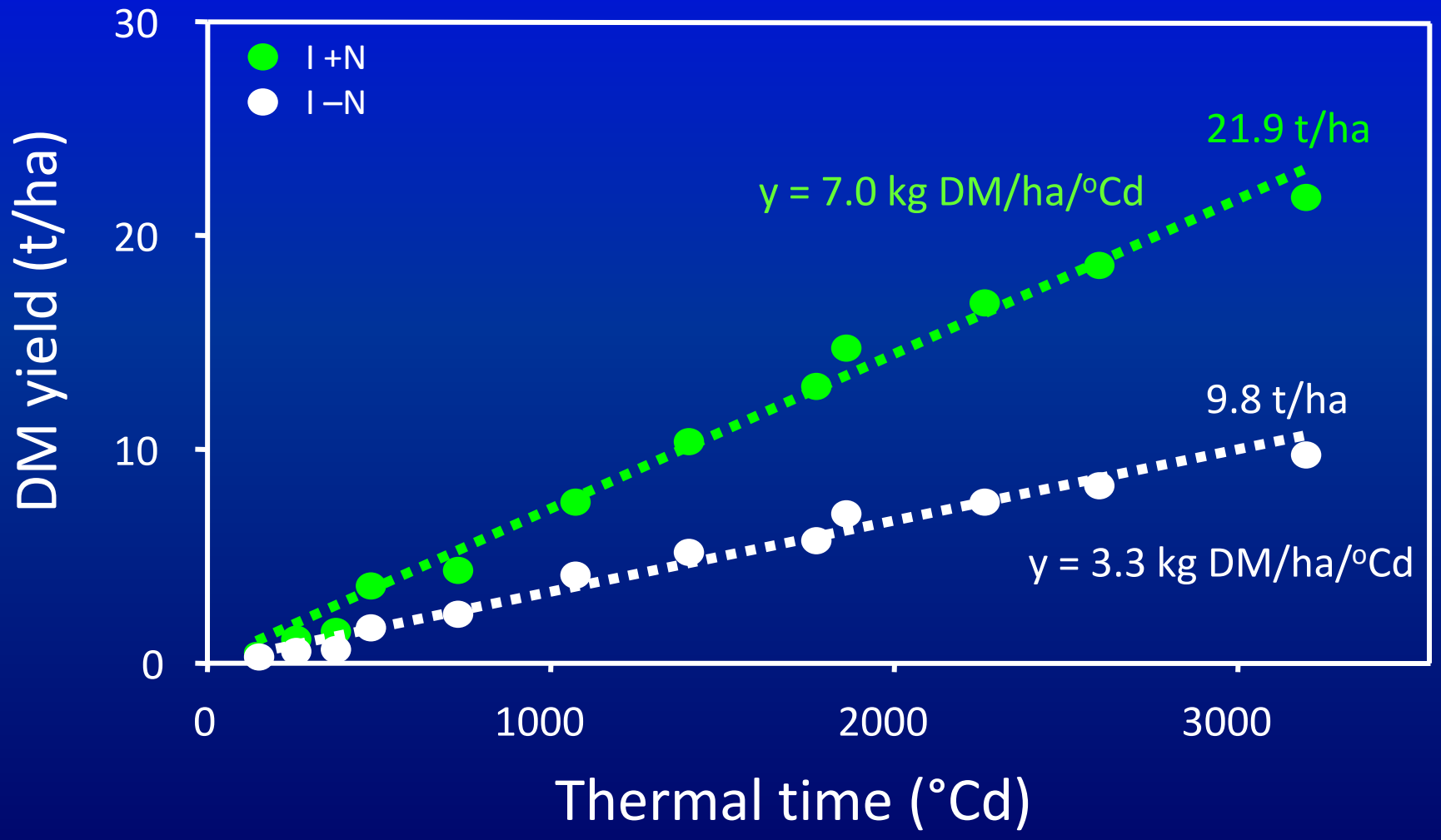


Photo: Keith Pollock
Lincoln University

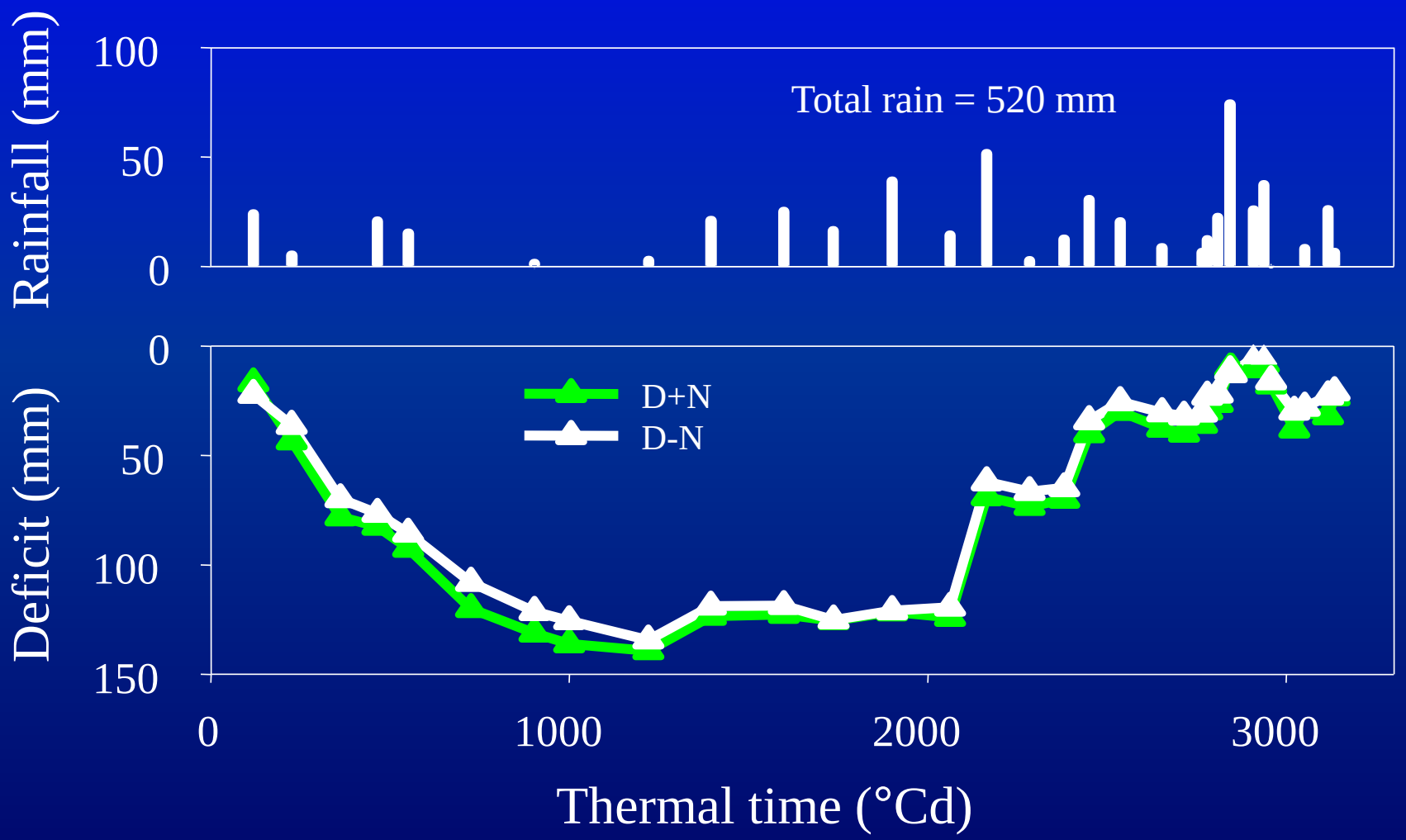
The Nitrogen gap



Source: Mills *et al*. 2006

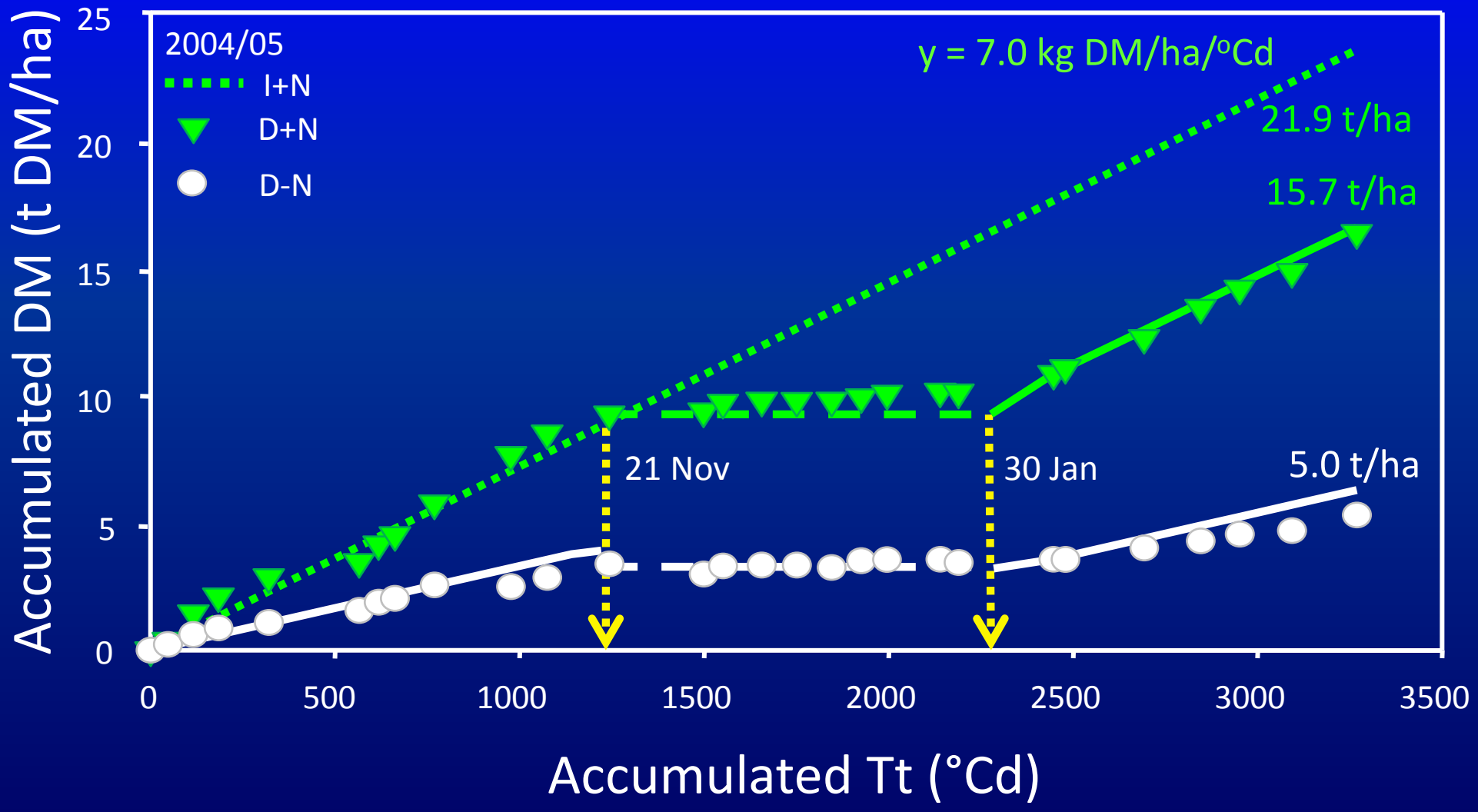

Summer ⇒ moisture response
Photo: Anna Mills
Lincoln University

Soil moisture deficit 2003/04



Source: Mills *et al*. 2006

The Nitrogen gap

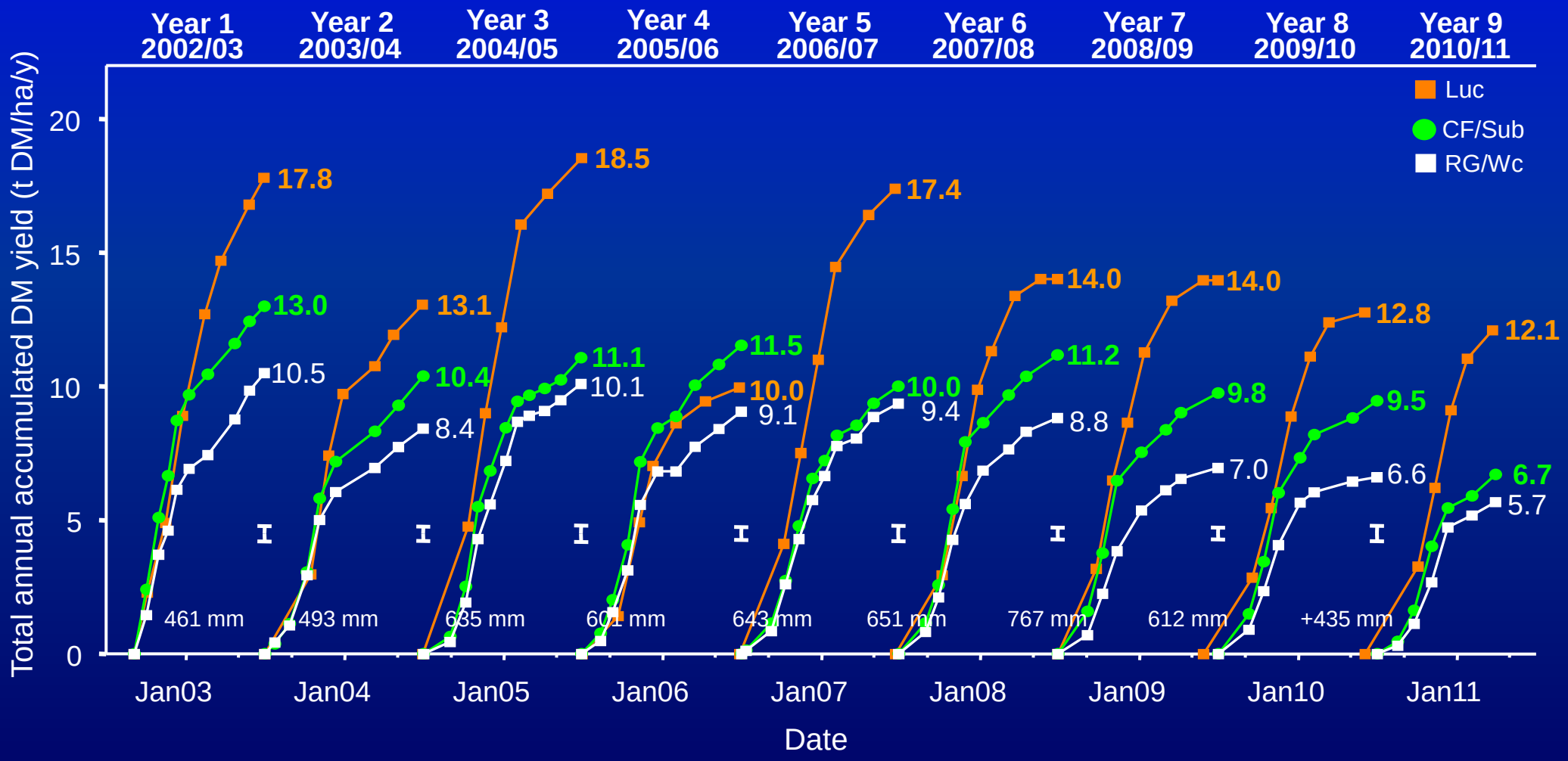


Source: Mills *et al*. 2006

‘MaxClover’

‘MaxClover’ Total DM Yields

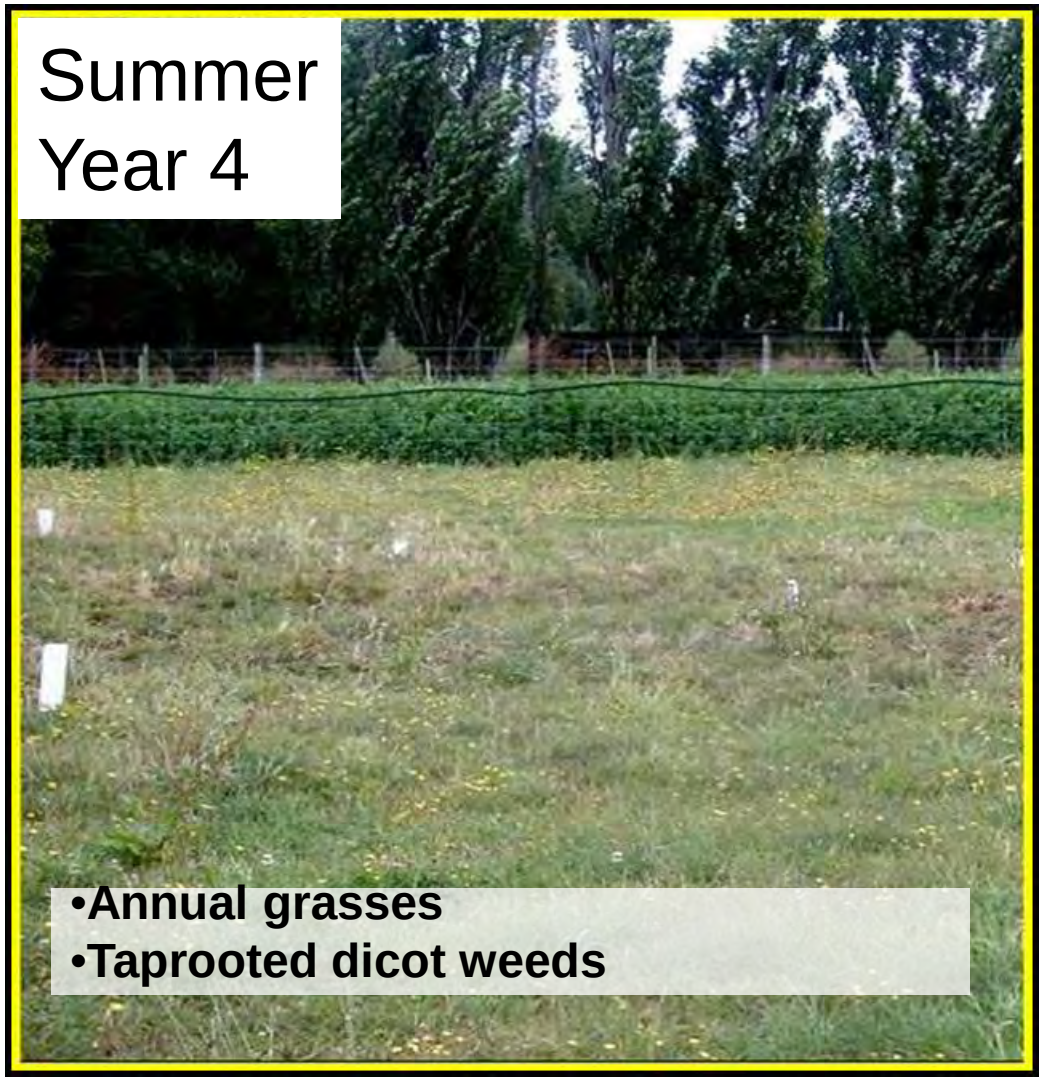
(to 30 March 2011)



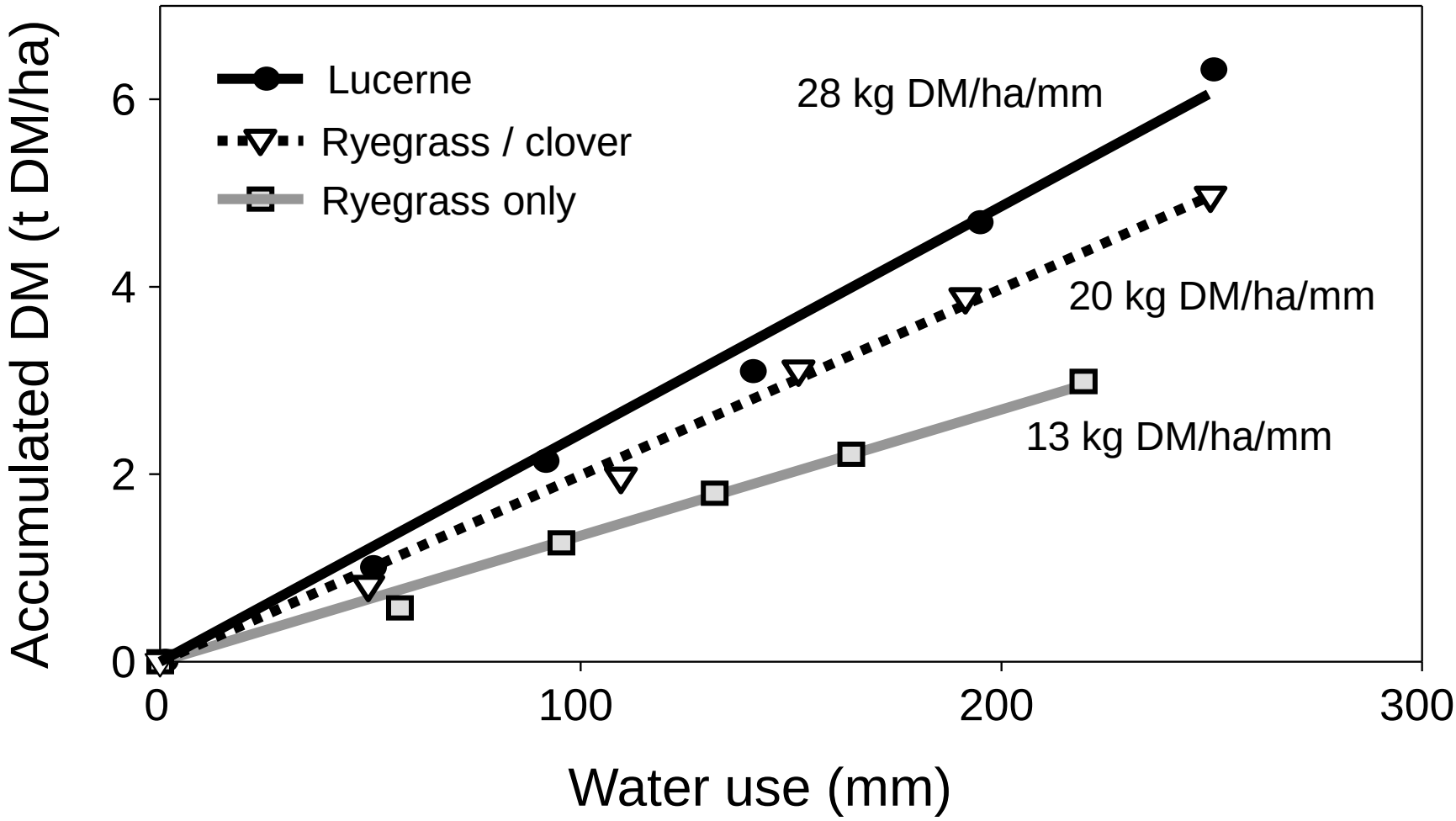
Source: Moot 2012

RG/Wc pastures

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



Spring WUE: legume = (nitrogen)



Source: Moot *et al*. 2008

Nitrogen deficient pasture

1000 kg N/ha

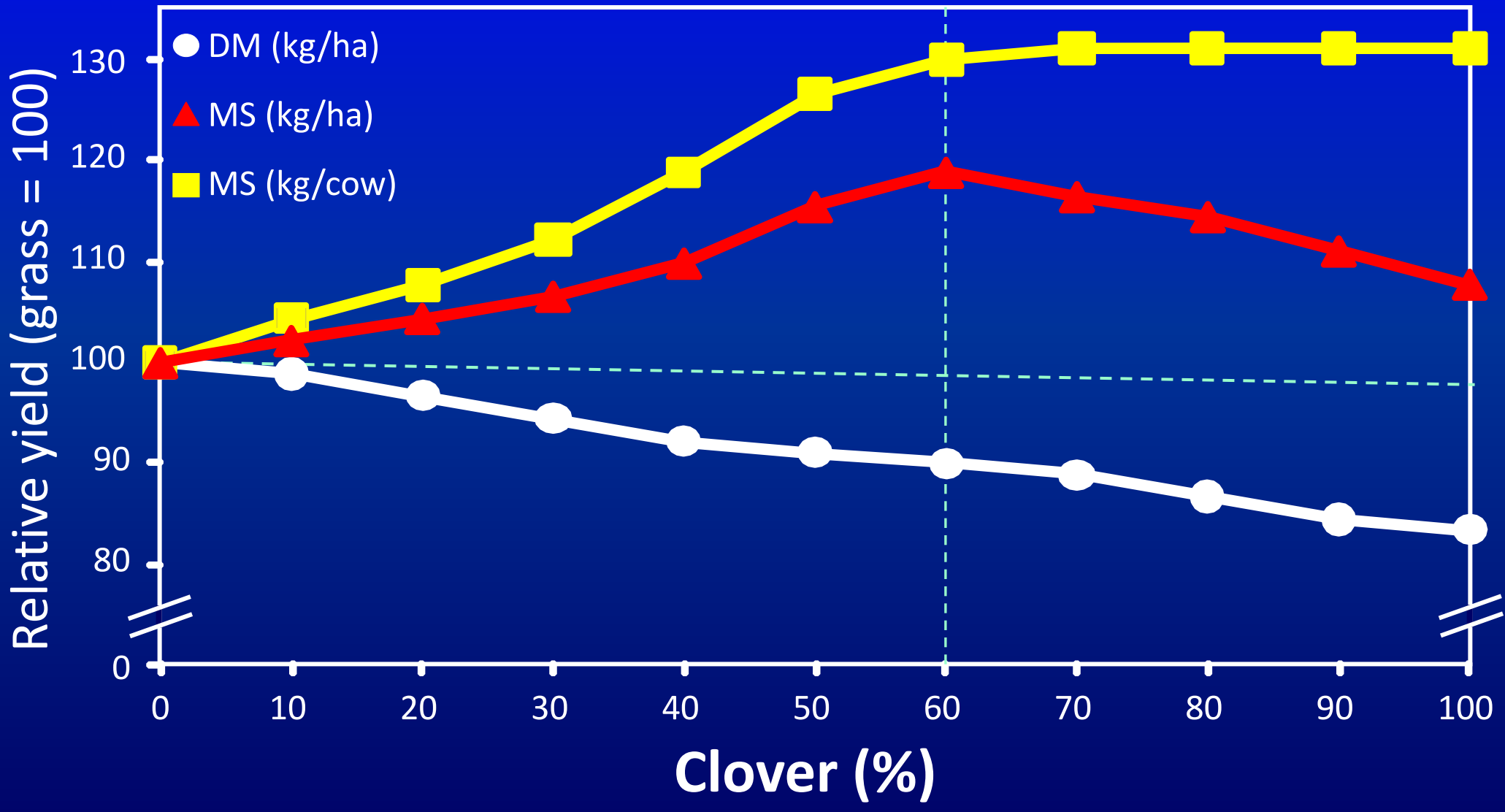
Photo: DJ Moot
Lincoln University

Sheep prefer 70% legume, 30% grass

40% white clover

Photo: DJ Moot
Lincoln University

Clover content & milksolids production



Source: Cosgrove 2005

Daily lamb live weight gains in summer/autumn when intake was maximised in experiments using ryegrass & white clover pastures as the control. (Source: P Kemp, adapted from Kemp *et al.* 2010)

Forage	g/day	Range (No. expts)
Ryegrasses/ white clover	154	56 – 226 (10)
Herb/legume	246	246 – 247 (2)
Chicory	254	192 – 290 (3)
Plantain	214	207 – 222 (2)
Red clover	298	292 – 305 (2)
White clover	259	226 – 282 (3)
Lucerne	230	210 – 243 (3)
Birdsfoot trefoil	258	258 (1)
Leaf turnips	245	245 (1)
Mean	251	

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
- 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<6


Olsen P>20

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

Perennial ryegrass

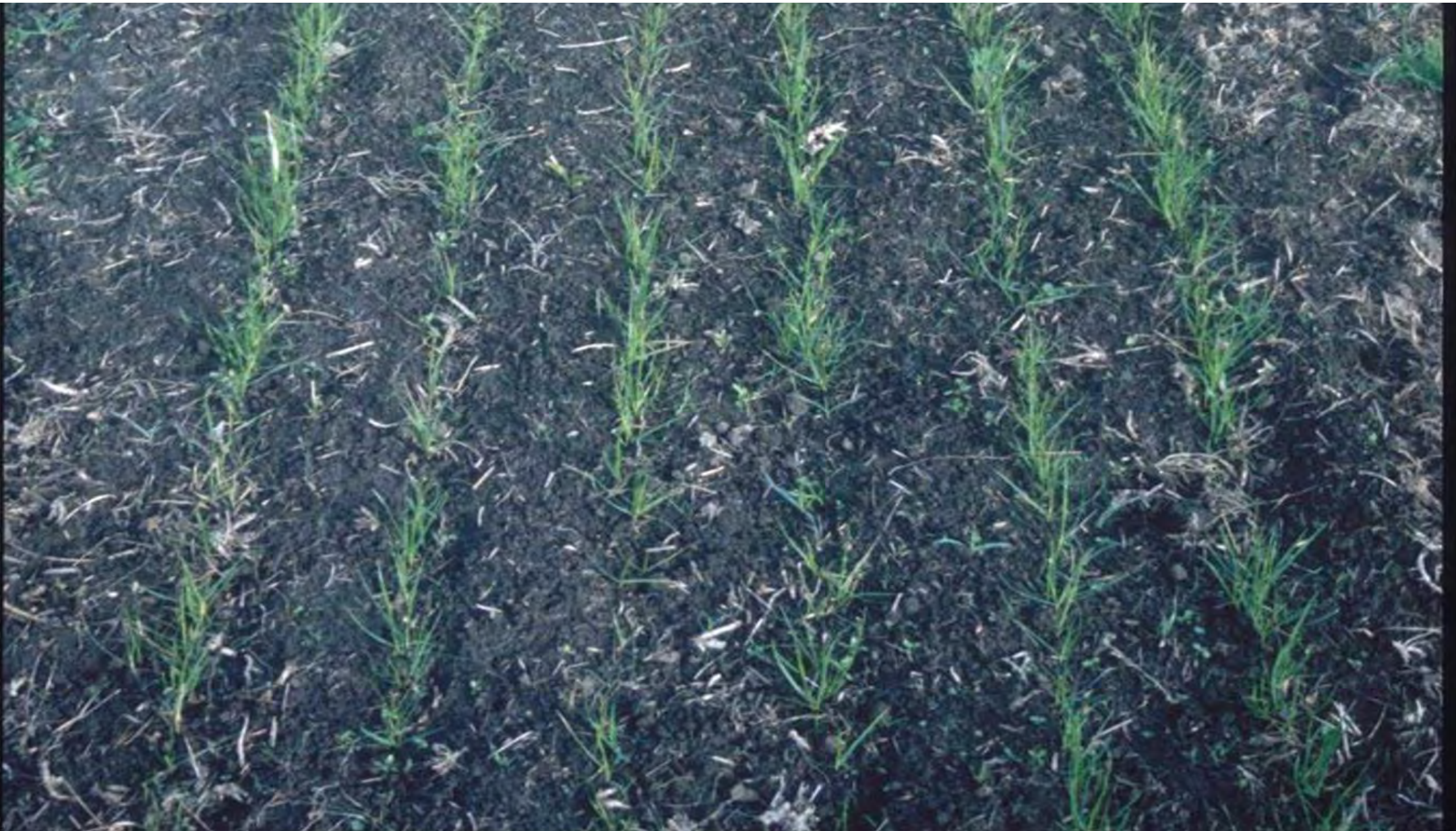
White clover

Photos: A Black
Lincoln University

Ryegrass sowing rate

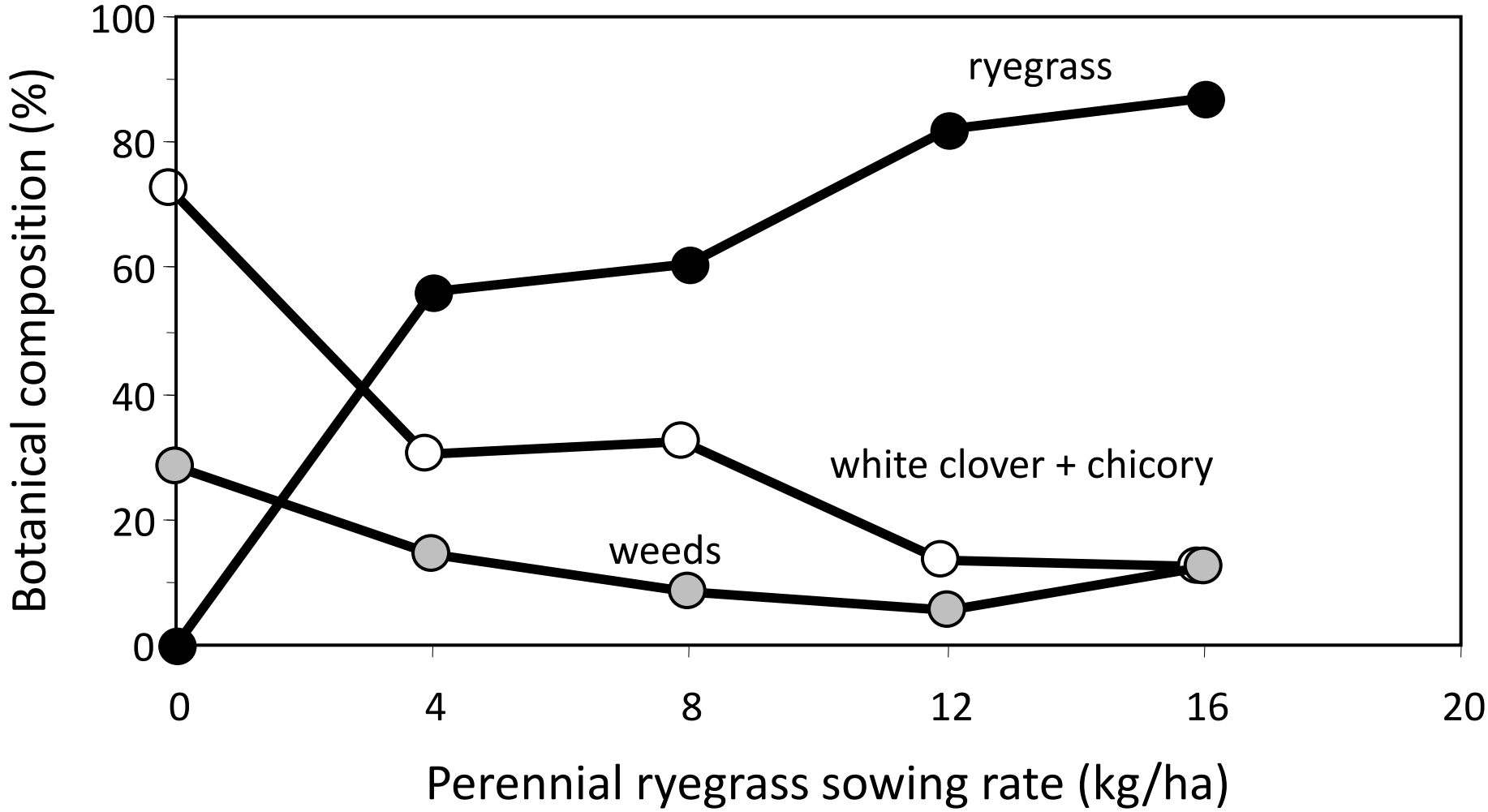
White clover @ 4 weeks

Perennial ryegrass @ 4 weeks



Italian ryegrass @ 4 weeks

Botanical composition



Source: Dumbleton, 1997

20% white clover

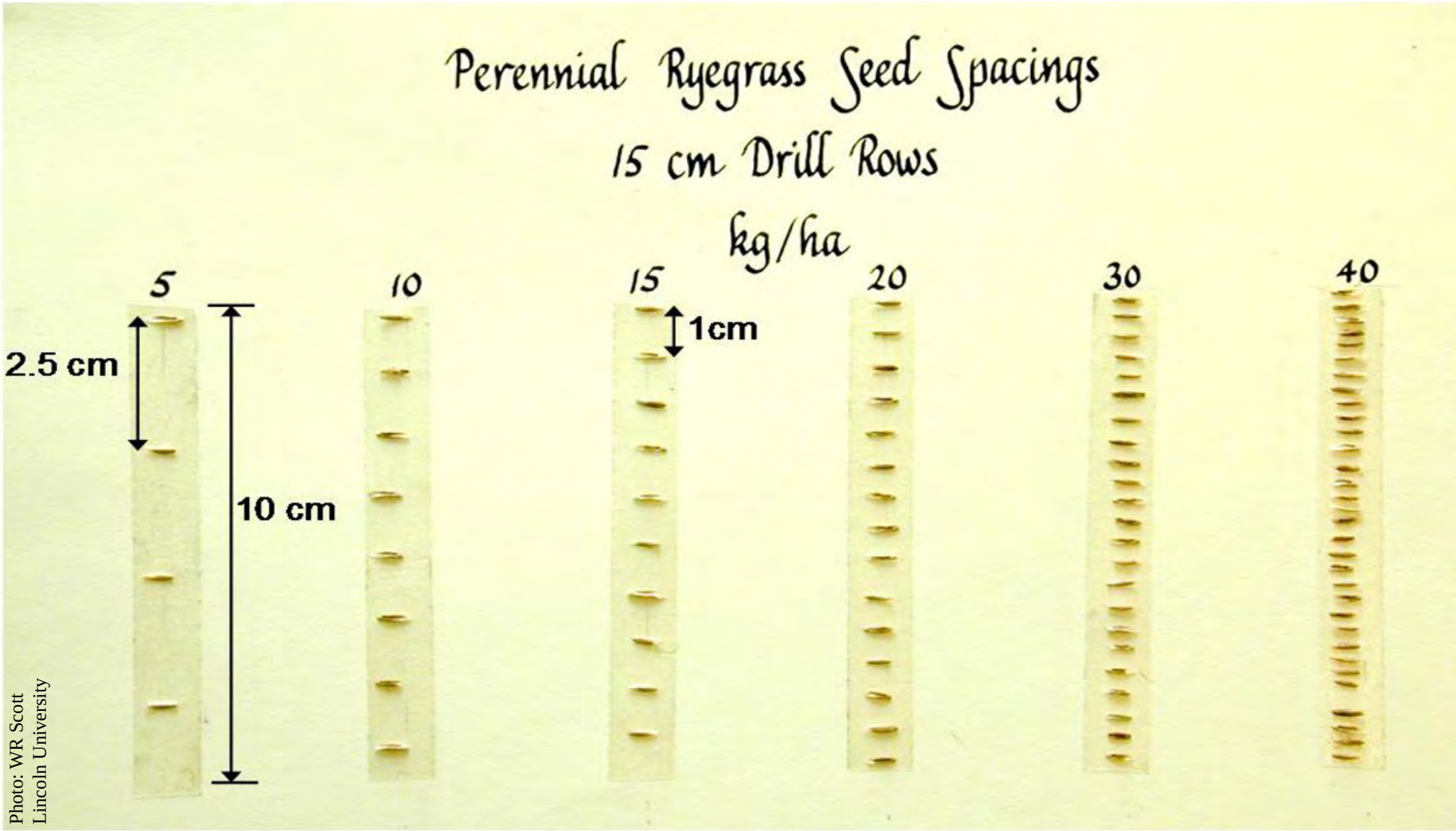
Photo: DJ Moot
Lincoln University

Number of seeds sown /m²

Ryegrass rate	Ryegrass (seeds/m²)	White clover (3 kg/ha)	Chicory (1.5 kg/ha)	Total (# of seeds)
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

Source: Dumbleton, 1997

Sowing rates



Summary: White clover

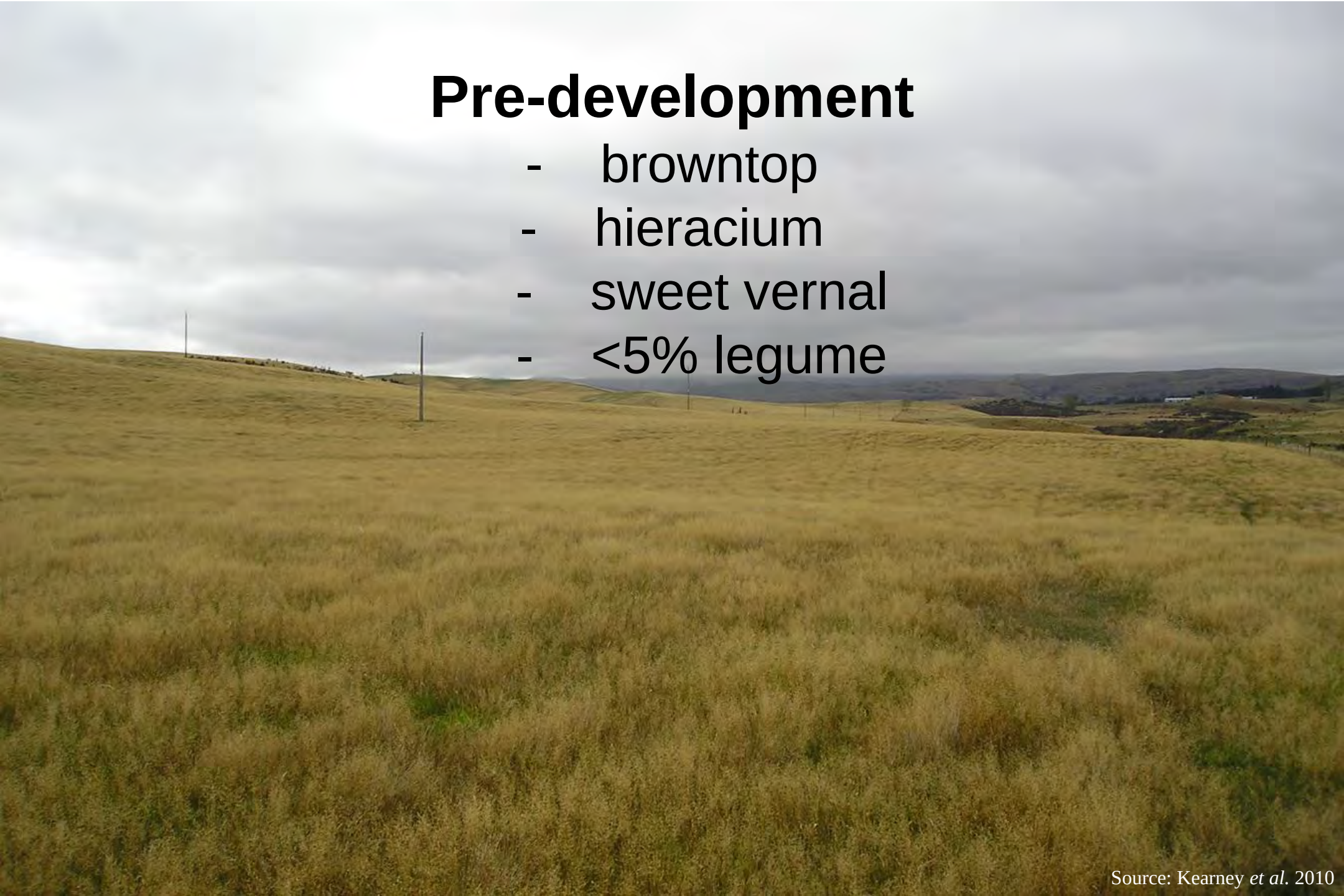
- Autumn sowing
    - soil temperature >14 °C
- Drilled with 8-10 kg/ha ryegrass in a well prepared seed bed!
- Nutrients (P) maintained
- Manage for white clover (18 months) and each spring!

Ryegrass/clover vs. Lucerne

1. Lucerne establishment

Soils
- deep free draining
- pH 6.0 – 7.0
- rg/wc fertility

Sowing
- inoculated
- 10-25 mm
- bare or coated 8-10 kg/ha
- spring or autumn (grass grub)
- cultivated or direct drilled
- after fallow?



Pre-development

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

Source: Kearney *et al.* 2010

Lime and Fertiliser Application

Lime 3-5 ton/ha

Fertiliser 250-500kg/ha

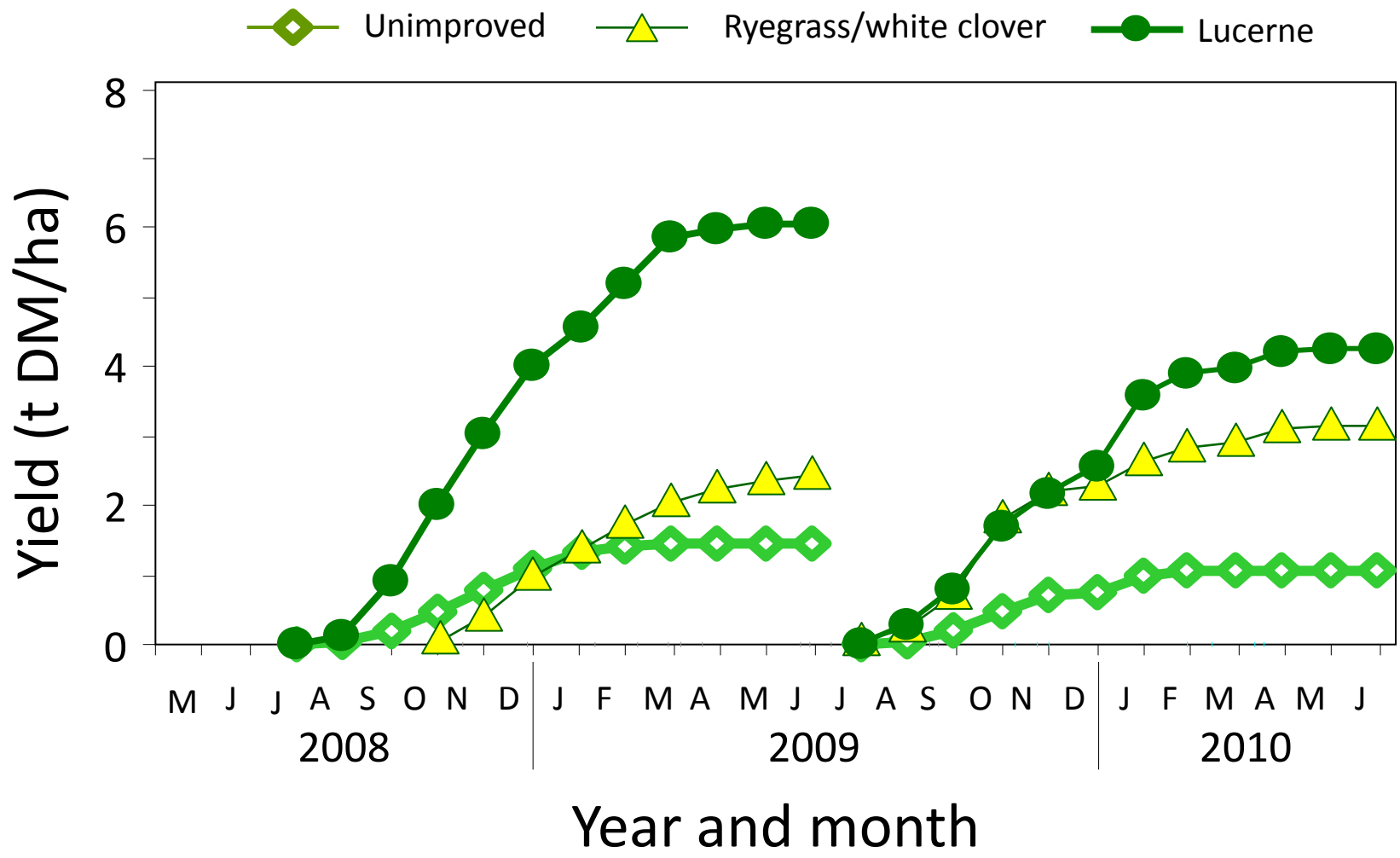
Source: Kearney *et al*. 2010


2nd Spray – Spring
Glyphosate, insecticide, penetrant
Result from Autumn spray, photo taken 1 November 2010
Source: Kearney *et al*. 2010


Drilling seed with fertiliser
Direct drilling = seed + fertiliser
Source: Kearney *et al.* 2010

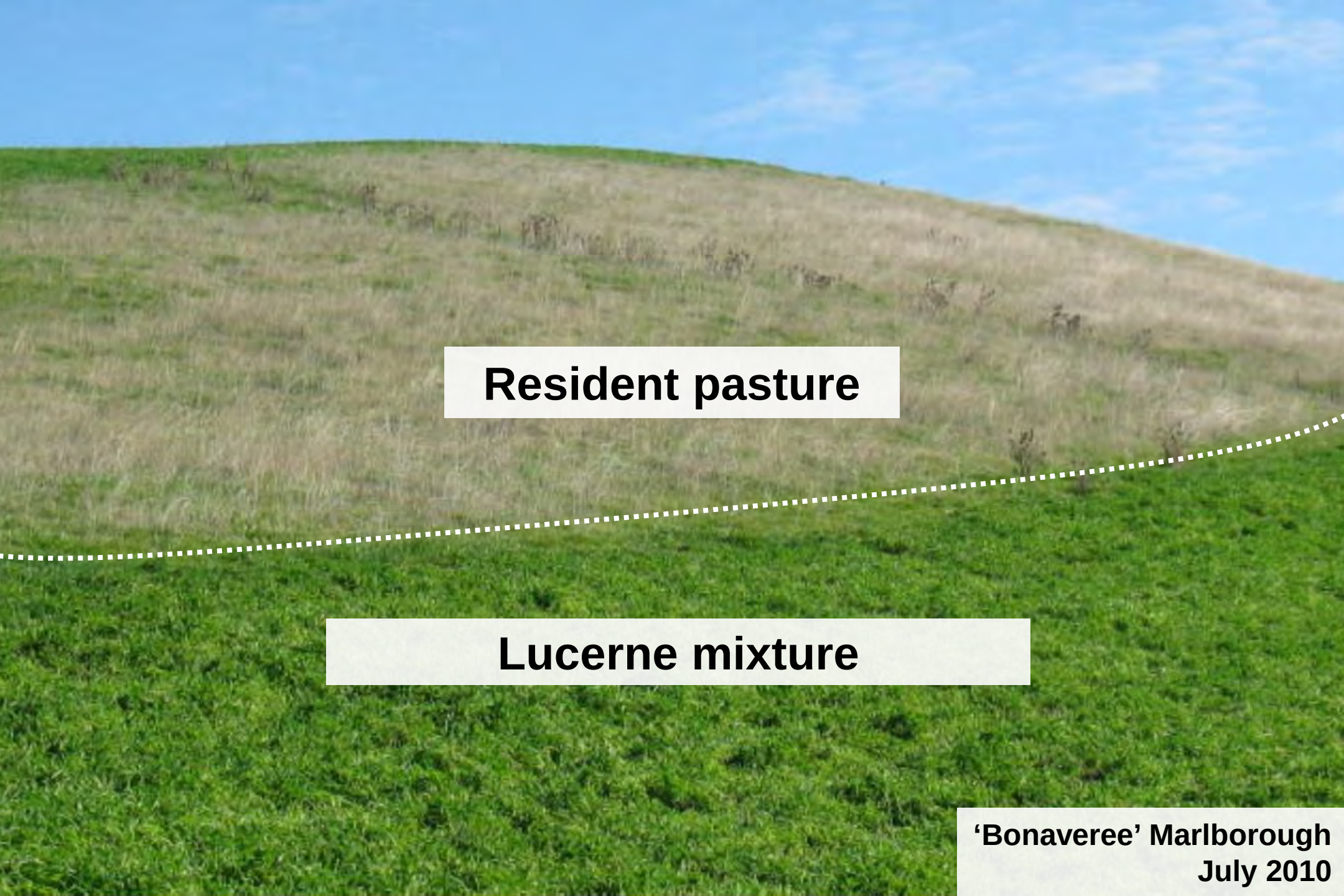
Source: Kearney *et al.* 2010

Pasture growth



Source: Kearney *et al.* 2010

Doug and Fraser Avery “Bonavaree”



‘Bonaveree’ Marlborough
July 2010

Maximize reliable spring growth – high priority stock

Legumes for Hill Country




Check website for David Grigg Tempello in Marlborough

http://www.lincoln.ac.nz/dryland

(- Field day hand outs and presentations-)

Photo: DJ Moot
Lincoln University

4 S's of hill country development

1) Subdivision – ***most important***

2) Stock – ***to control additional feed***

3) Super – ***for legumes***

4) Seed – ***not a silver bullet!***

Photo: DJ Moot
Lincoln University

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

agresearch

Source: Widdup *et al*. 2003

Subterranean Clover

Photo: K Pollock
Lincoln University

Subterranean Clover

- **Large seed, 10x wc therefore 10x sowing rate**
- **Winter annual**

  autumn sow soil temp. <11°C

- **Rapid but variable germination with rainfall from Jan-May**
- **When can seedlings be grazed in autumn?**
- **How to maximize summer seed set?**


1 April 2003


5 April 2003


9 April 2003


12 April 2003

Takes several years to build seed reserves

27 Oct 2003

Source: Costello & Costello 2003

Drilled pasture mix

8 kg AR1/AR37 perennial ryegrass

10 kg subterranean clover

early and late flowering cultivars

1½ kg white clover

1 kg cocksfoot

Hill country = 10 kg/ha sub. alone

Subterranean clover tool kit

- **Autumn sowing (10 kg/ha = 150 seeds/m^2)**
- **Difficult to oversow – manage current population**
- **“Finger and thumb” test - minimal seedling failure at six-leaf stage (~30 days after rain)**
- **Manage for seed set in 3-5 years (2000/m^2)**

  - light-moderate set-stock in spring PGPM >1200

  - cattle are great

  - flowering ~ 80 days before summer dry

  - hard graze cover before autumn rain PGPM=800

Alternative clovers + annual forages

‘Bolta’ balansa clover: 25th Sept ‘06

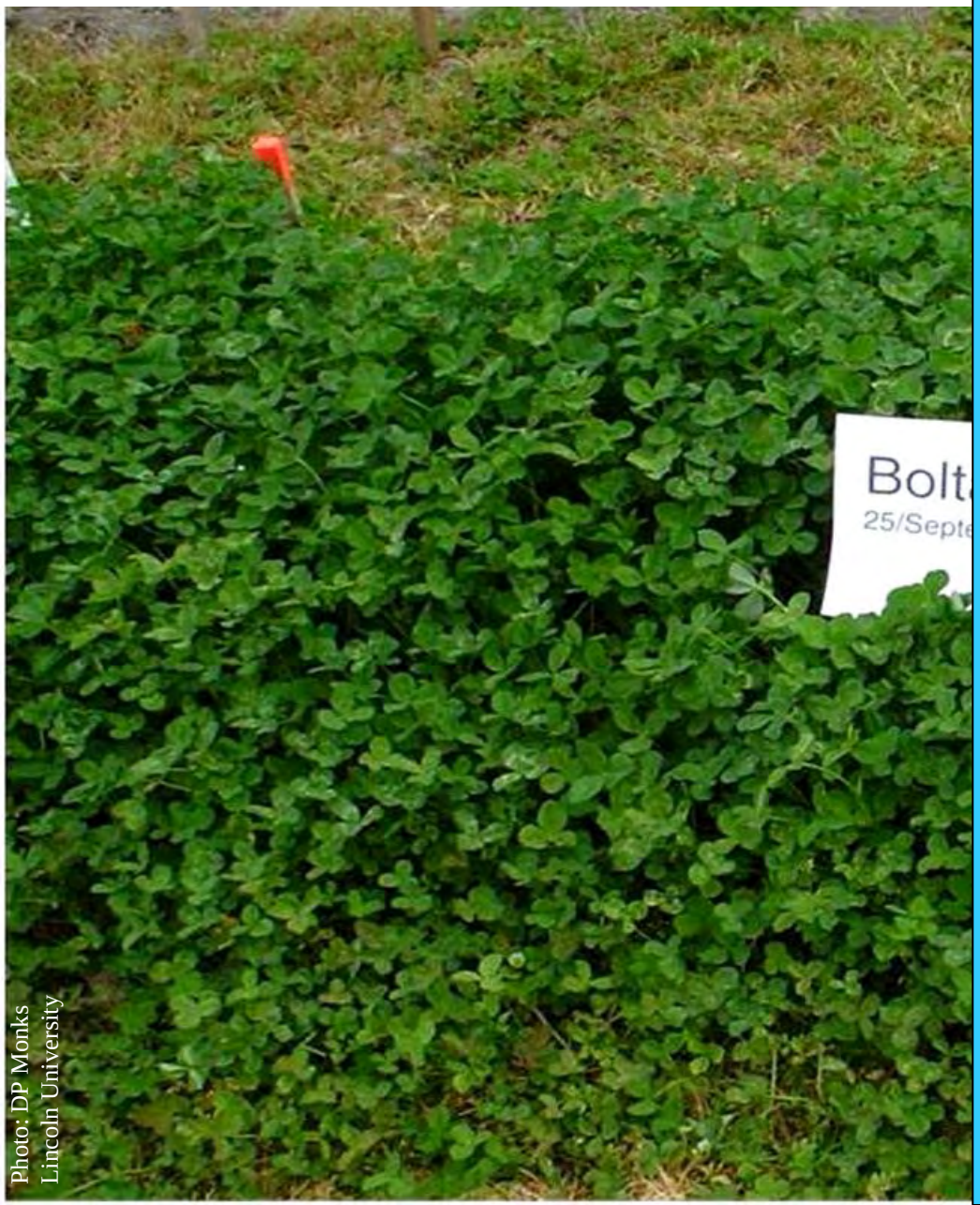


Photo: DP Monks
Lincoln University

10 Oct ‘08

End of summer must have 50% bare

Photo: DP Monks
Lincoln University

21 Feb

Photo: DP Monks
Lincoln University

Build seed bank in first year


Early flower – late Sept


Late flower – mid Oct


Seed maturing – early Nov


Mature seed – late Nov

Gland clover

Photo: Bog Roy


16 Oct 2011
Photo: Bog Roy

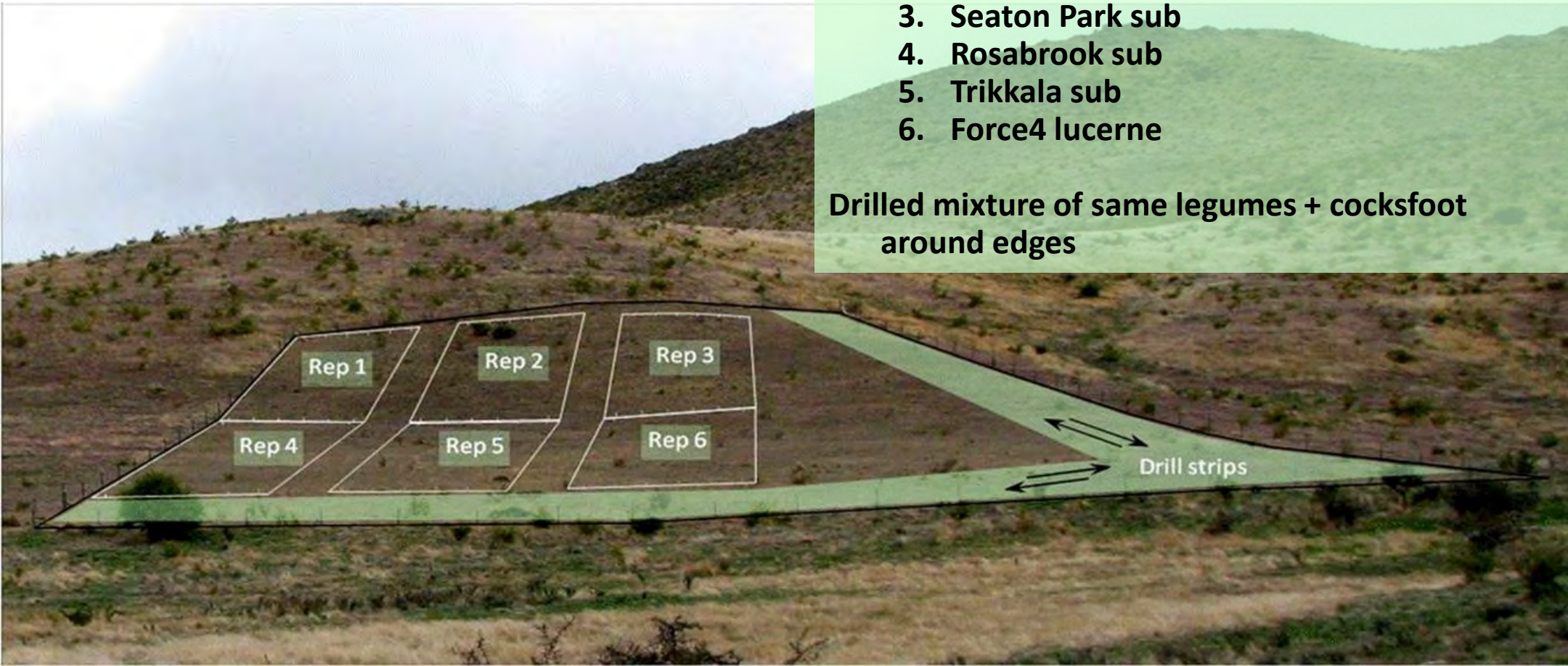
Bog Roy

Experimental: Five annual clovers vs. lucerne

Individual species – 6 reps, hand broadcast

1. **Prima gland**
2. **Bolta balansa**
3. **Seaton Park sub**
4. **Rosabrook sub**
5. **Trikkala sub**
6. **Force4 lucerne**

Drilled mixture of same legumes + cocksfoot around edges




24 Mar 2012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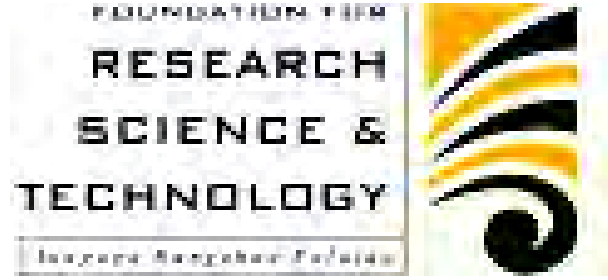
Conclusions

- Huge production potential behind the farm gate
- Require regionally **specific** technical solutions and ongoing extension.
- Nitrogen from legumes is the key to improve pastoral quality and water use efficiency.
- Lucerne, herbs and other legumes have a key role to play in pastoral farming for deer, beef, dairy and sheep.

Acknowledgements

- Beef & Lamb NZ Ltd/ Pastoral21
- Lincoln University
- MAF Sustainable Farming Fund



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