Hawkes Bay FMG 15 November 2017

Legumes reduce risk in dryland farming

Professor Derrick Moot

New Zealand's specialist land-based university

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Sustainable Farming Fund
Ministry of Agriculture and Forestry
Te Manatū Ahuwhenua, Ngāherehere

beef+lamb new zealand

Seed Force
the power to grow

Ballance agri-nutrients

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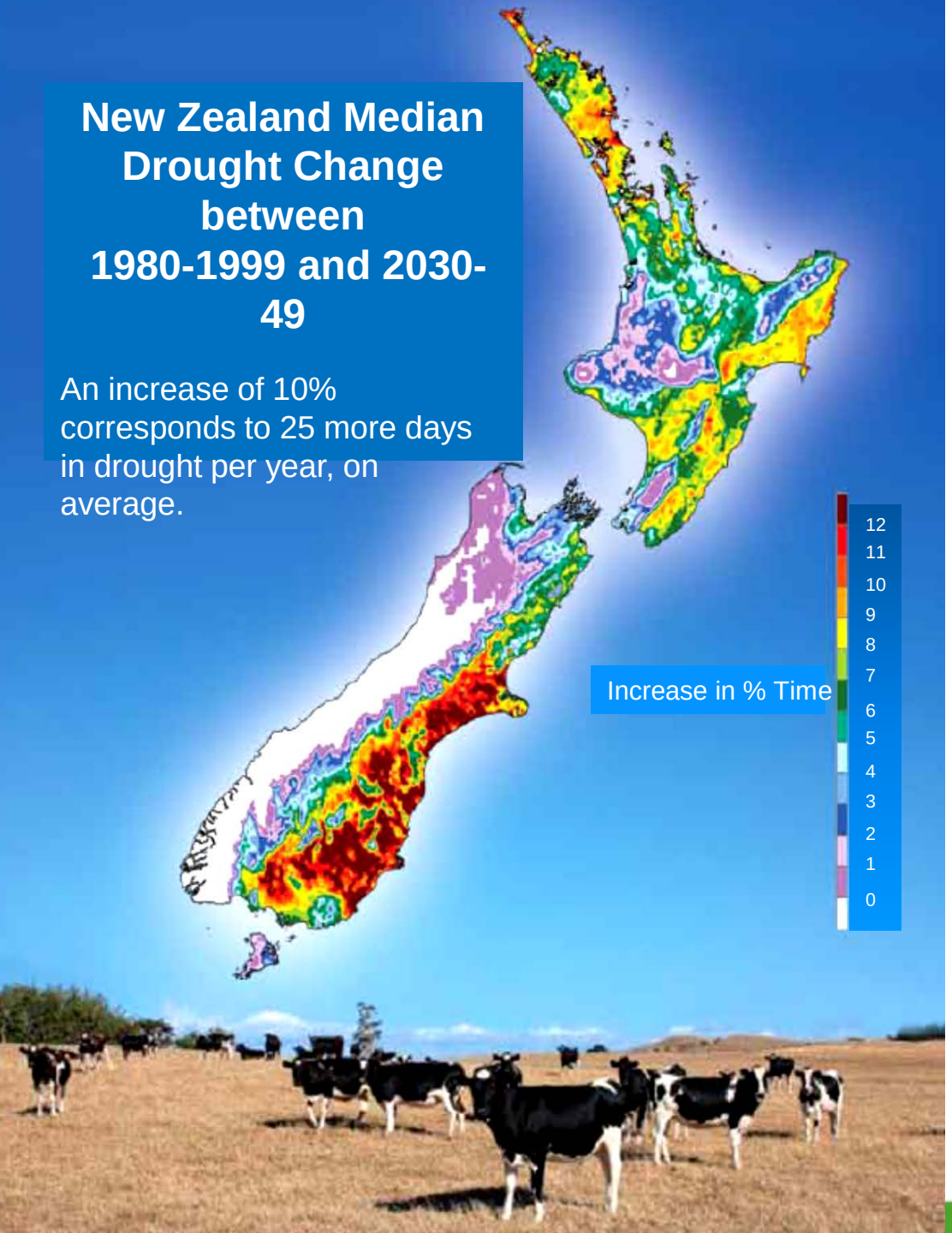
Understanding biology to reduce risks

- Background science – NTW
- Dryland case study – lucerne
- Hill country – annual clovers

Dryland pastures

- Soil water recharge most springs
- Low N fertilizer use
- High spring feed demand – breeding systems
- Adaptable to climate variability – future scenarios
- Sustainable – financially, socially, environmentally
- Limited cultivation possible
- Reduce risk of failure



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Predicted climate change in New Zealand by 2040

MPI-NIWA-Drought-in-a-Changing-Climate%20.pdf
http://www.mpi.govt.nz/document-vault/133

Experiment site

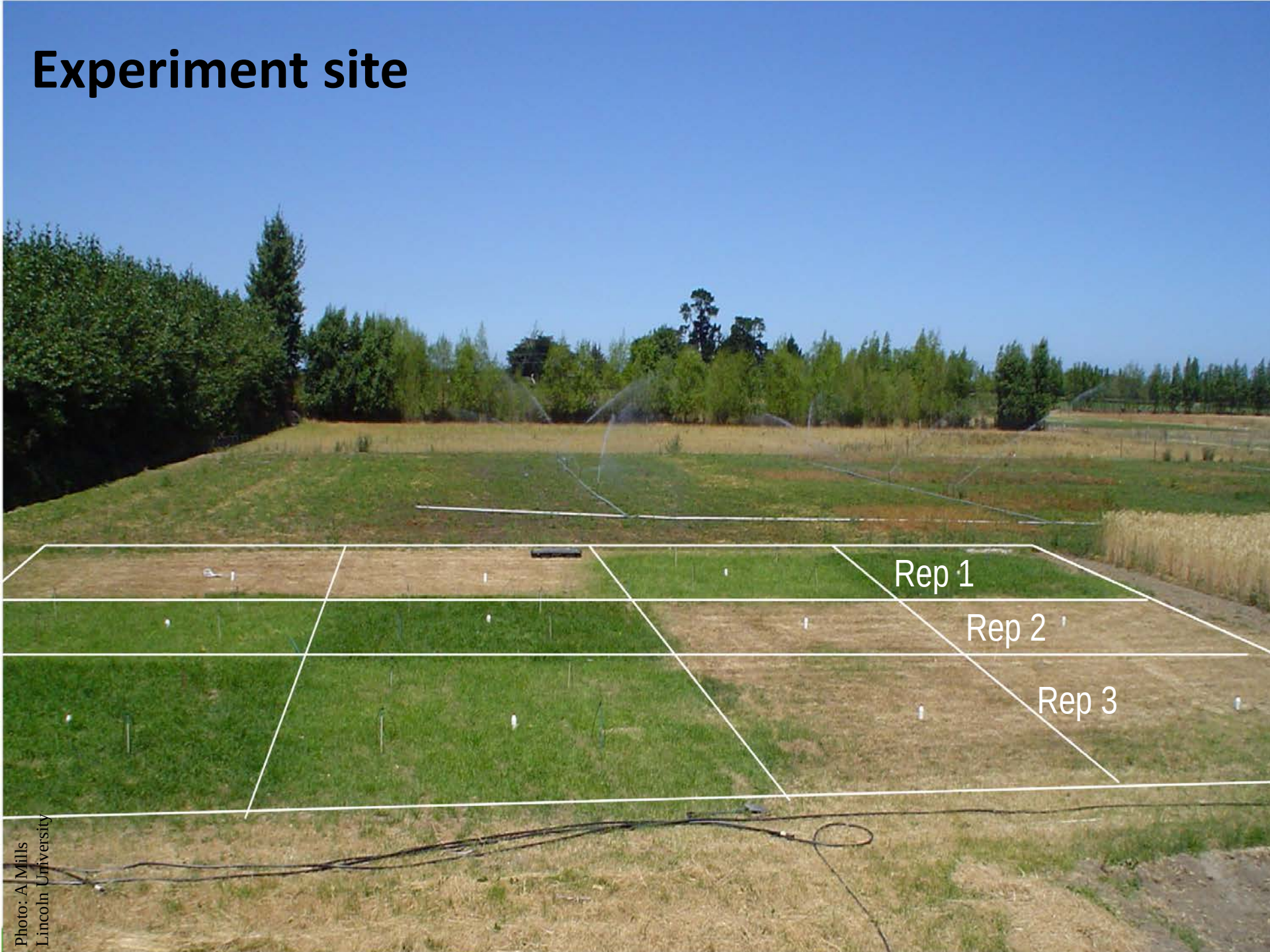
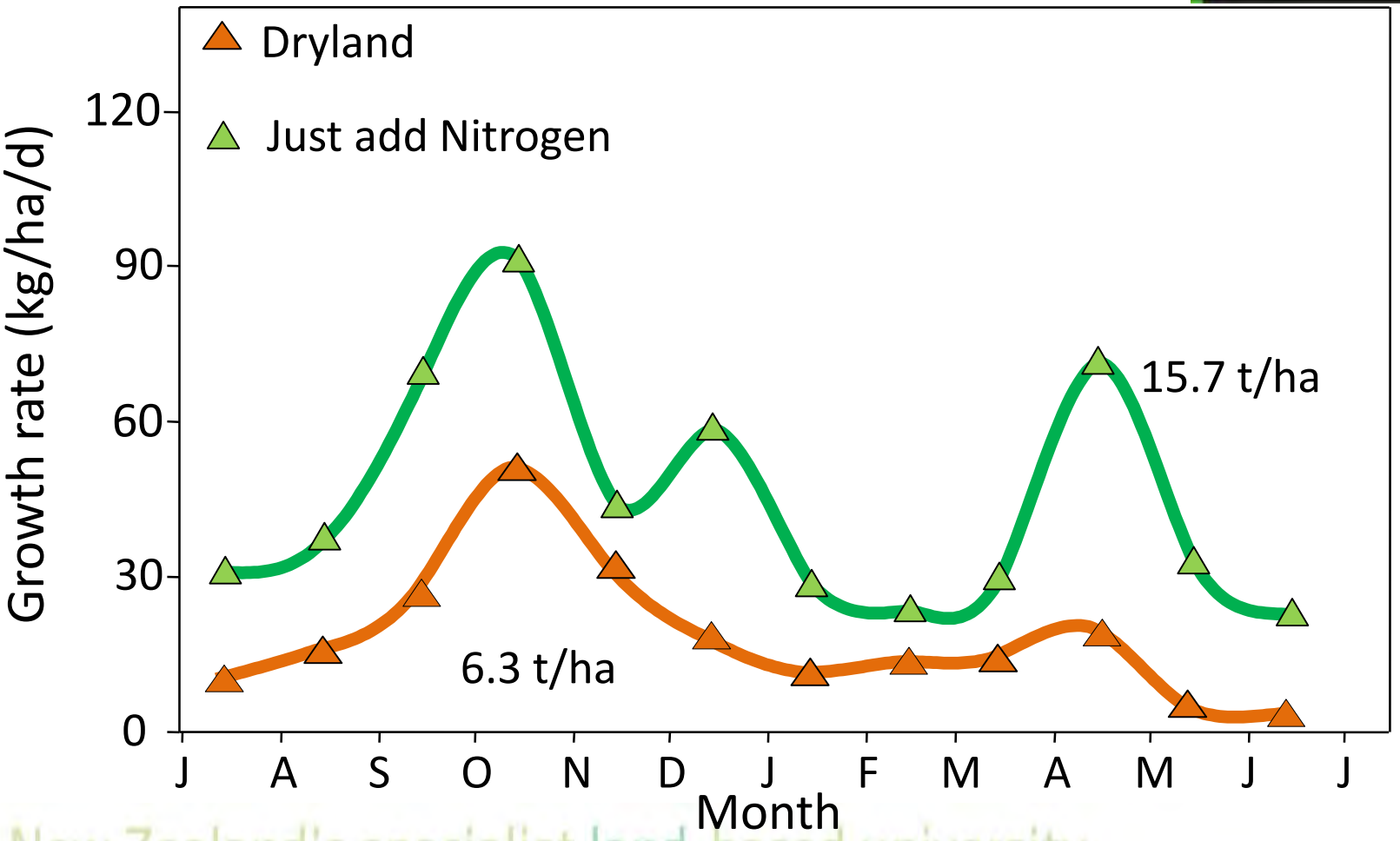


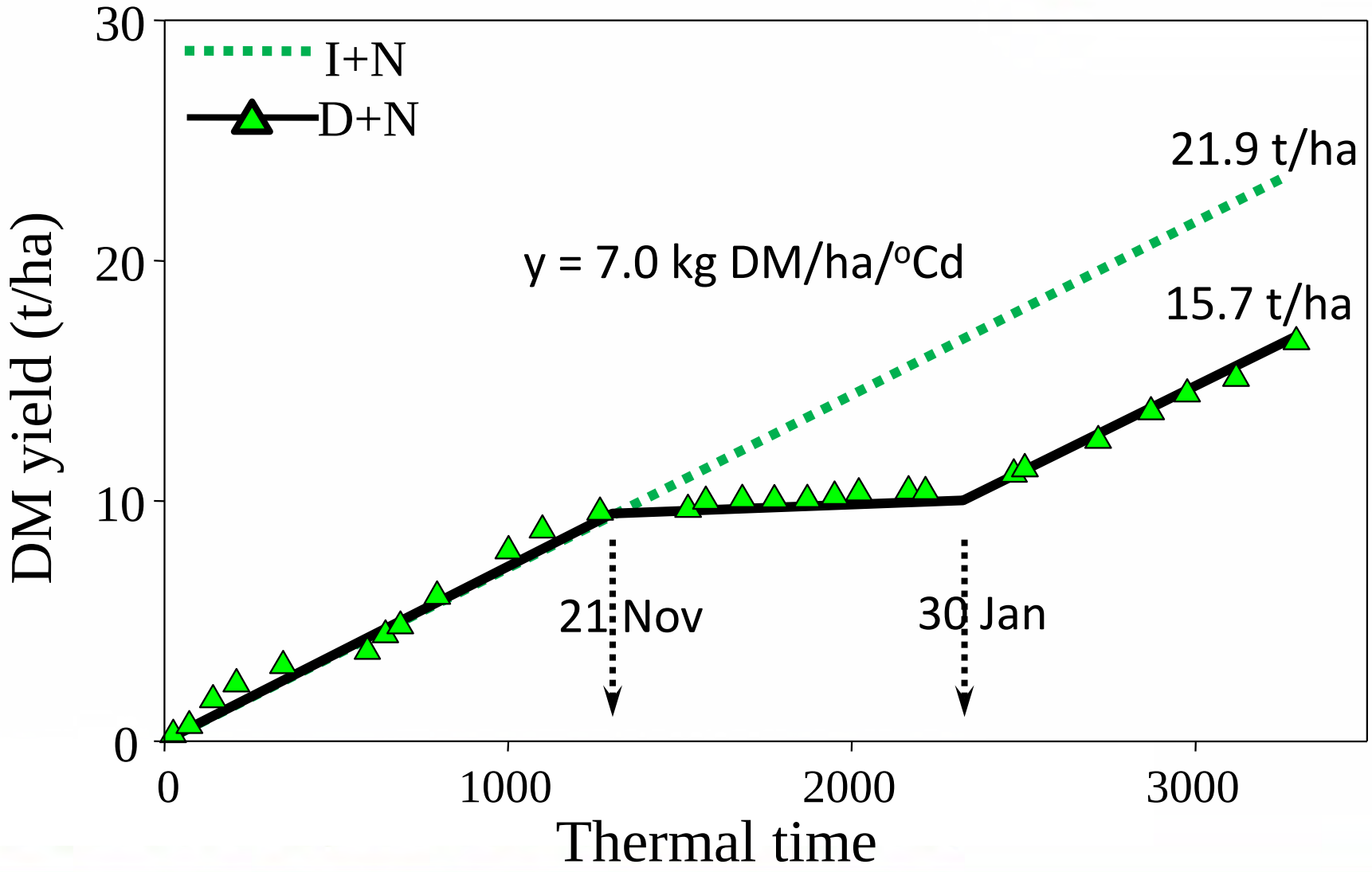
Photo: A Mills
Lincoln University

Growth rates (2 year means)



Mills *et al.* 2006, 2009

Water stress effect on yield



Mills *et al.* 2006

Soil moisture deficit 2003/04

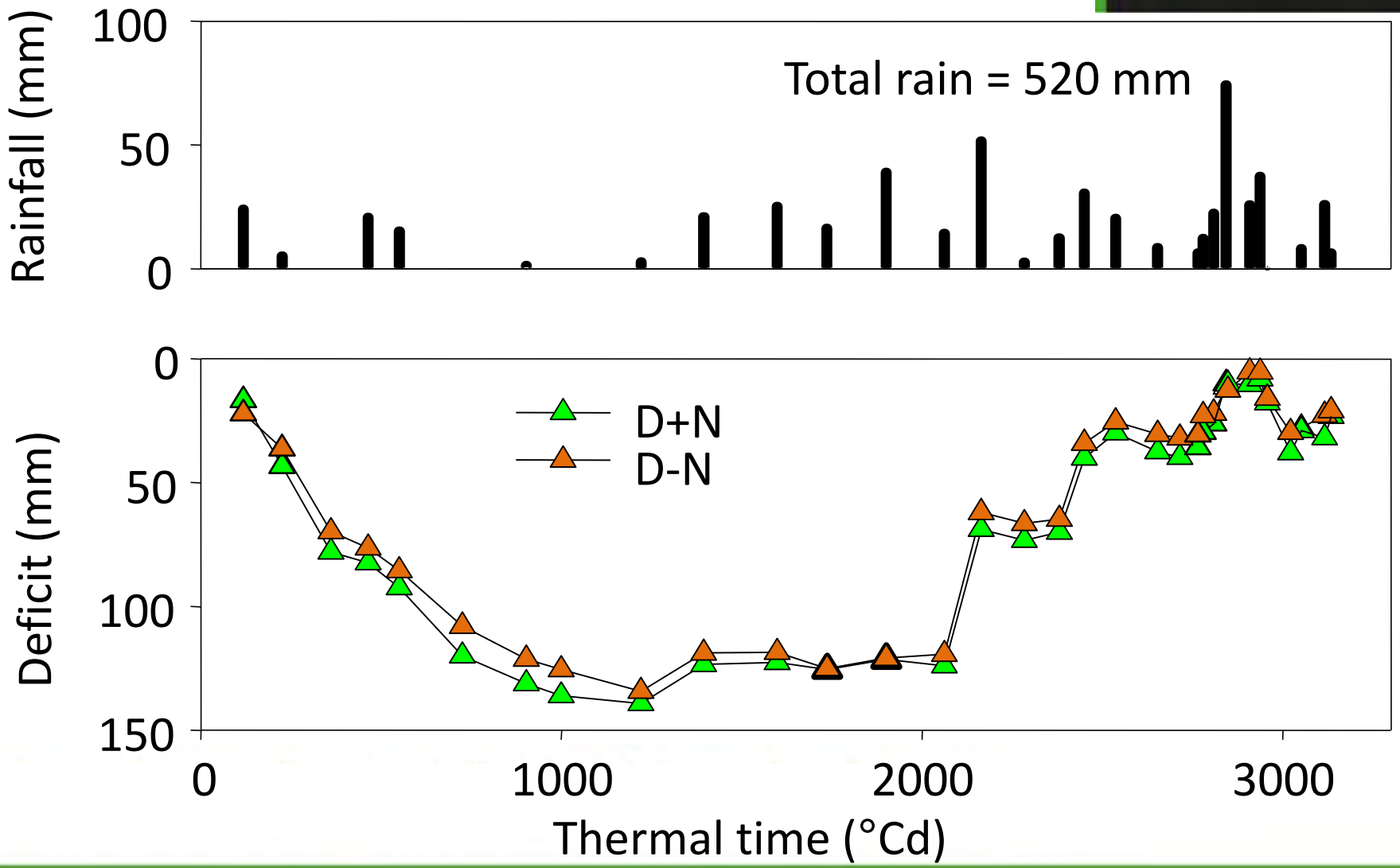
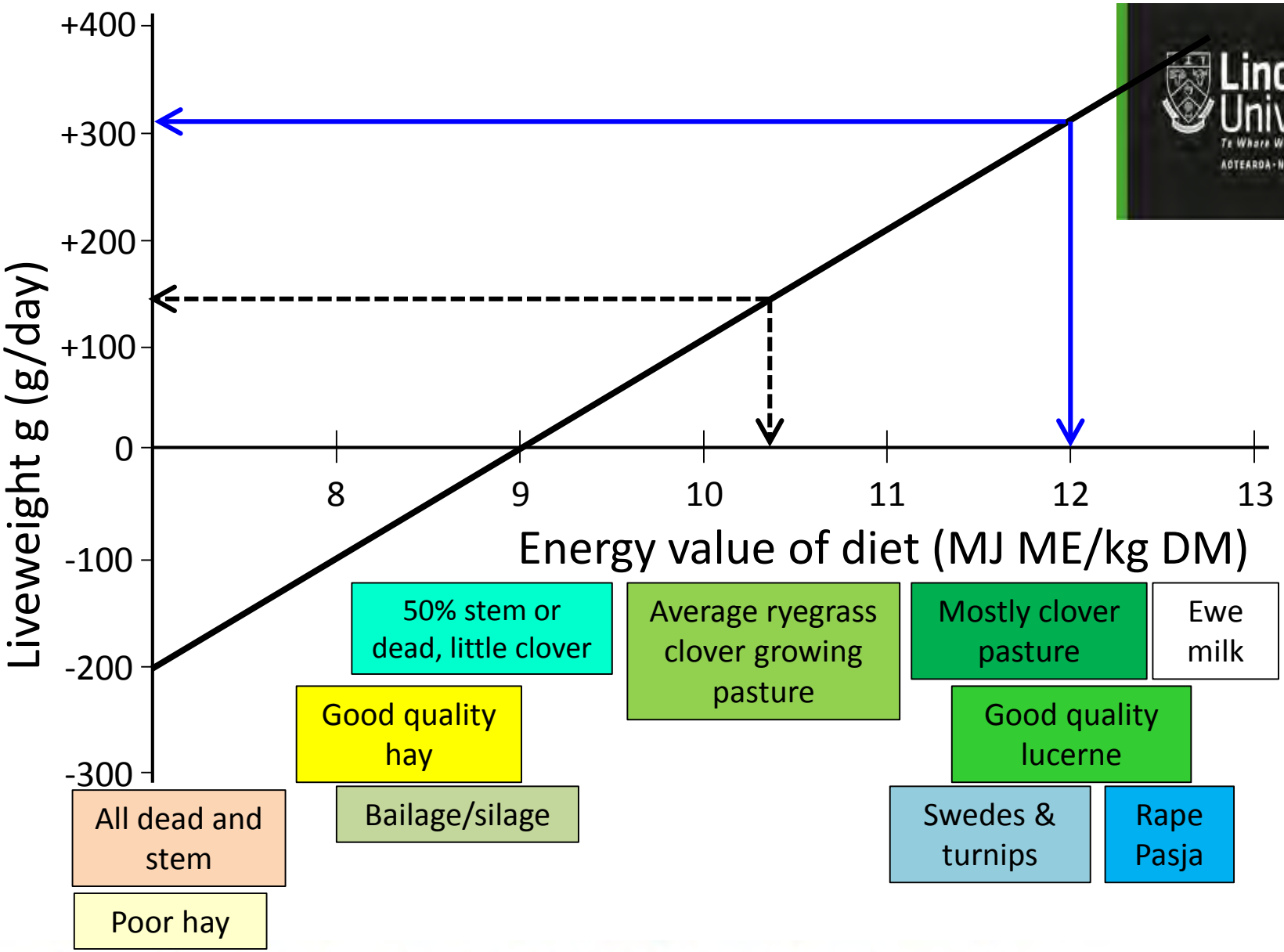
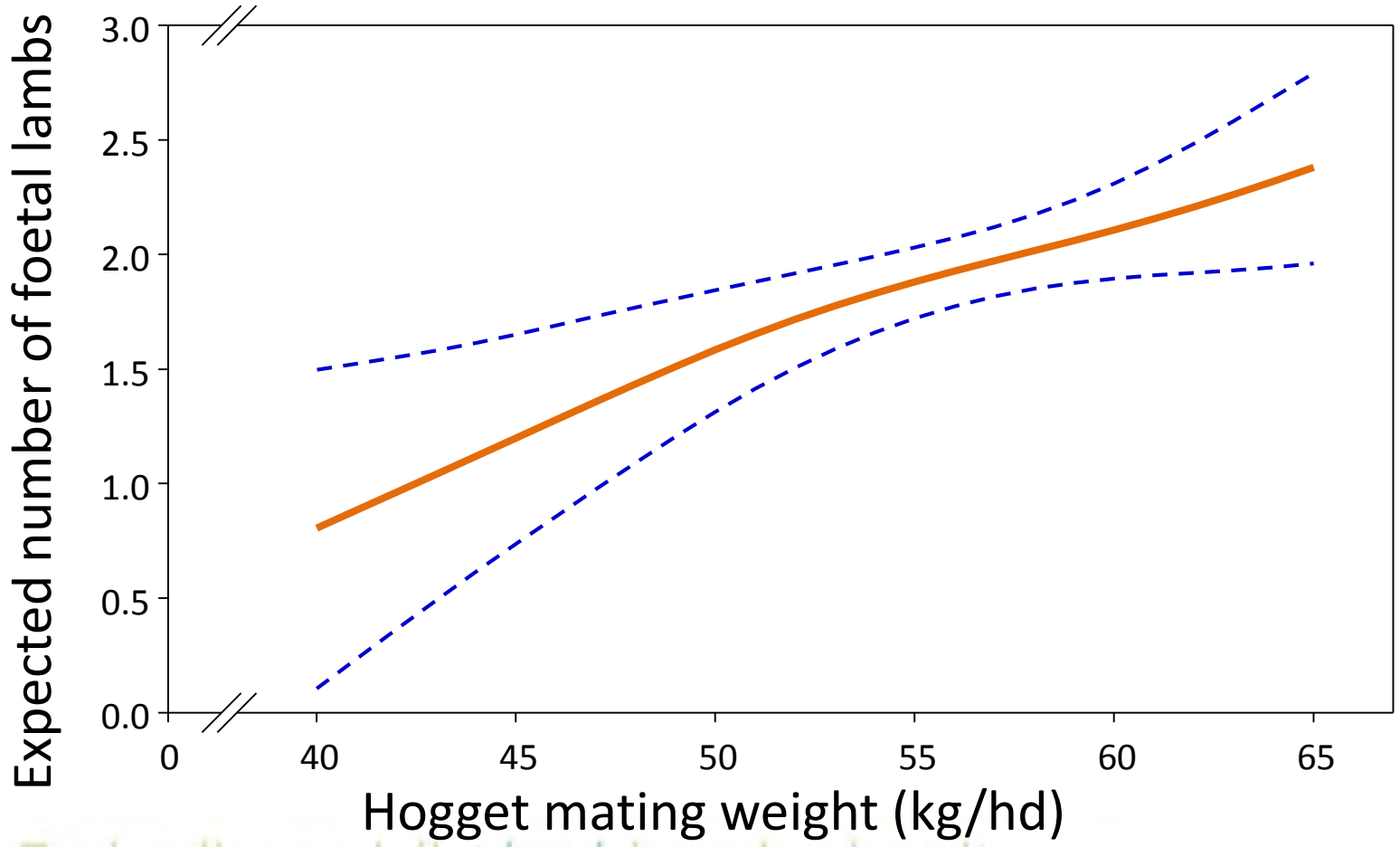


Photo: DJ Moot
Lincoln University



Adapted from Kerr 2010: 400 Plus. A guide to improved lamb growth

Foetal lambs vs. mating weight



Sheep prefer 70% legume, 30% grass

Photo: Jo Grigg
'Tempello' Marlborough

Photo: DP Monks
Lincoln University

Nitrogen fixation
25-30 kg N/t DM

Lucas *et al*. 2010

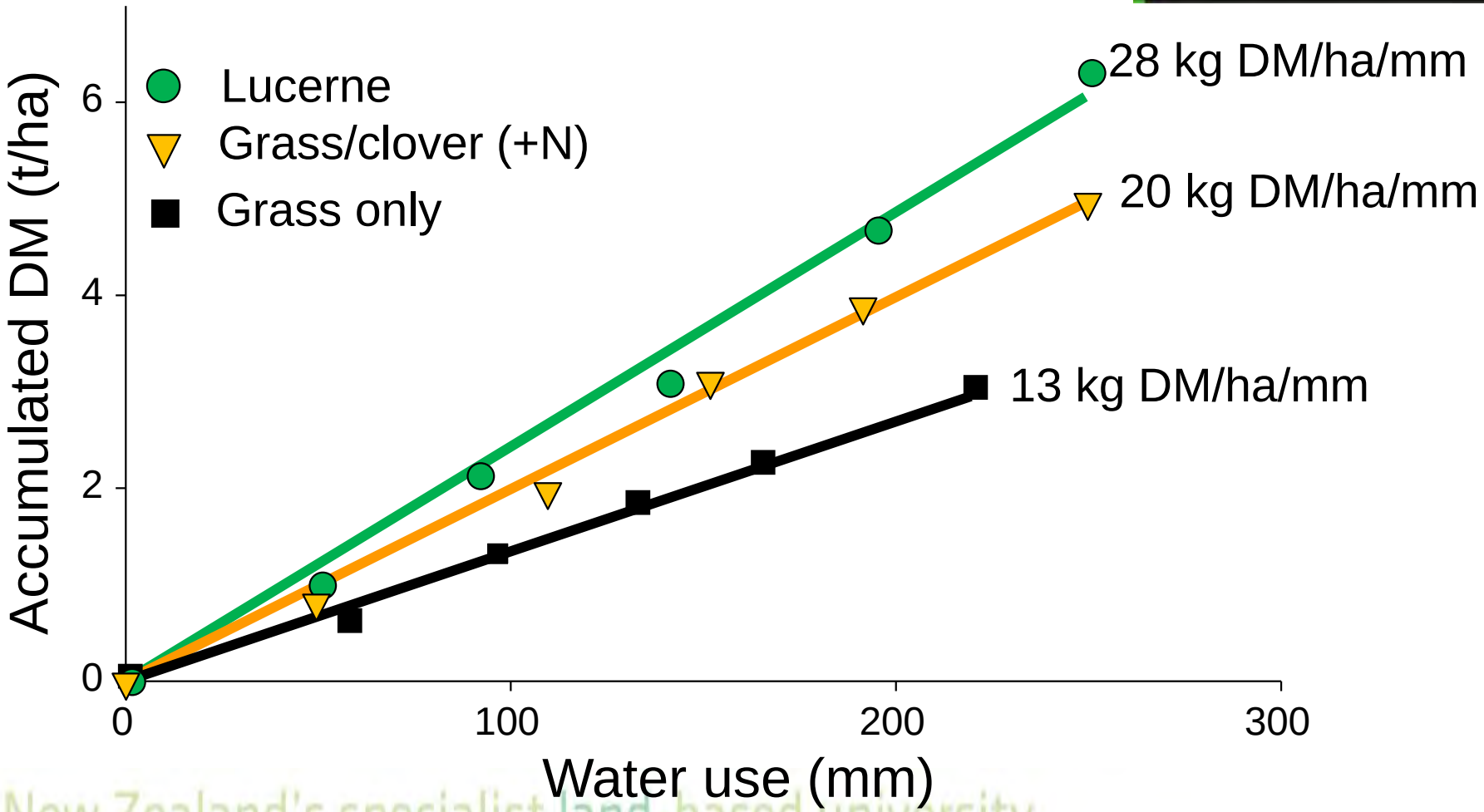
Efficient pastures

- Limited water supply
- N to make plants grow!
- Meet animal demand (lactation)
- Minimize impact on air, soil, water
- Productive and profitable
- Socially acceptable

Legume dominant

Bonavaree farm, Marlborough
Dryland lucerne conversion

Spring WUE



Moot *et al*. 2008

Bonavaree 14/8/2017

Photo: DJ Moot
Lincoln University

Seasonal grazing management

Spring

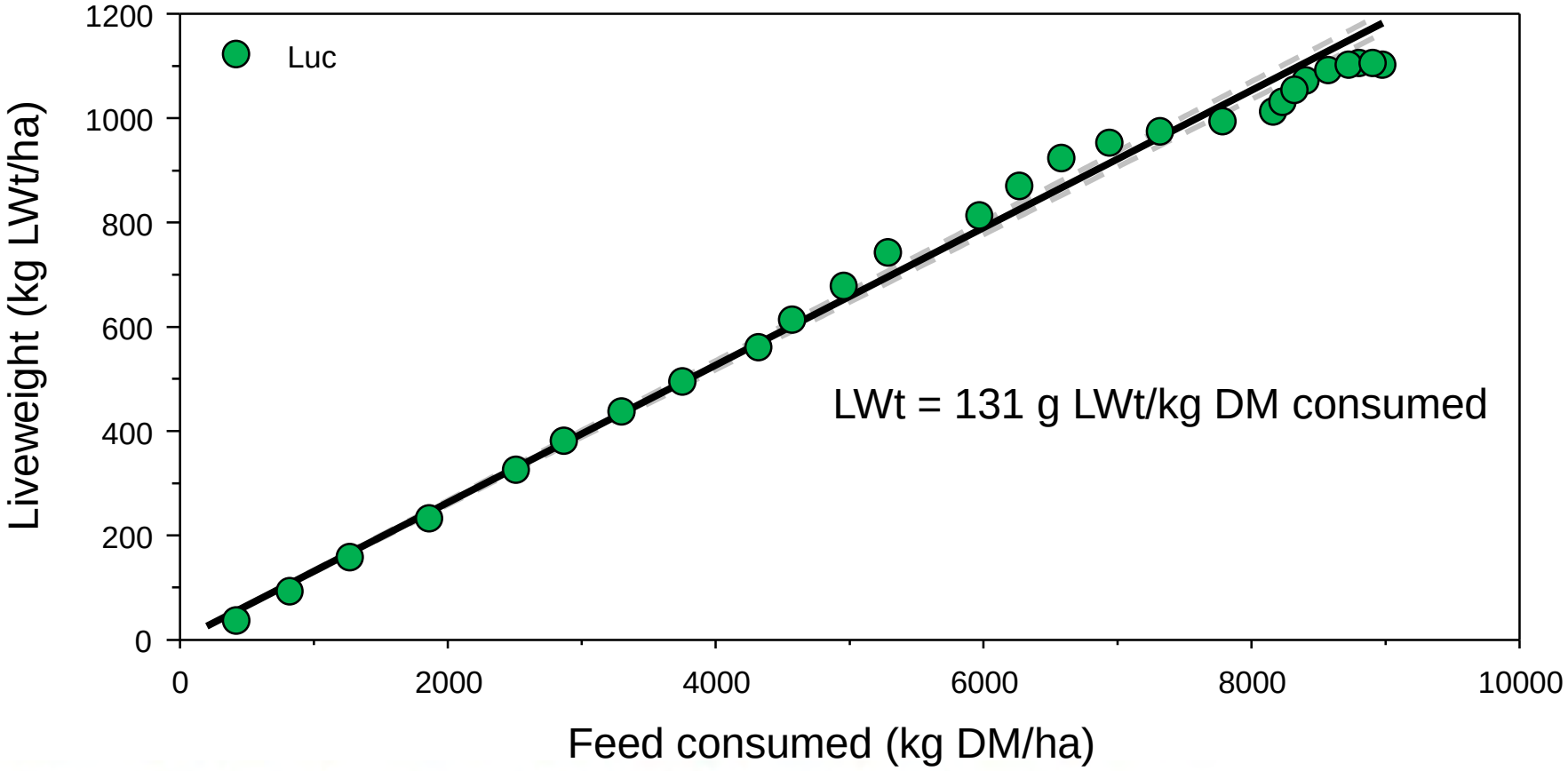
- 1st rotation aided by root reserves to produce high quality vegetative forage.

- can graze before flowers appear (~1500 kg DM/ha) ideally ewes and lambs but

Growing point at the top of the plant

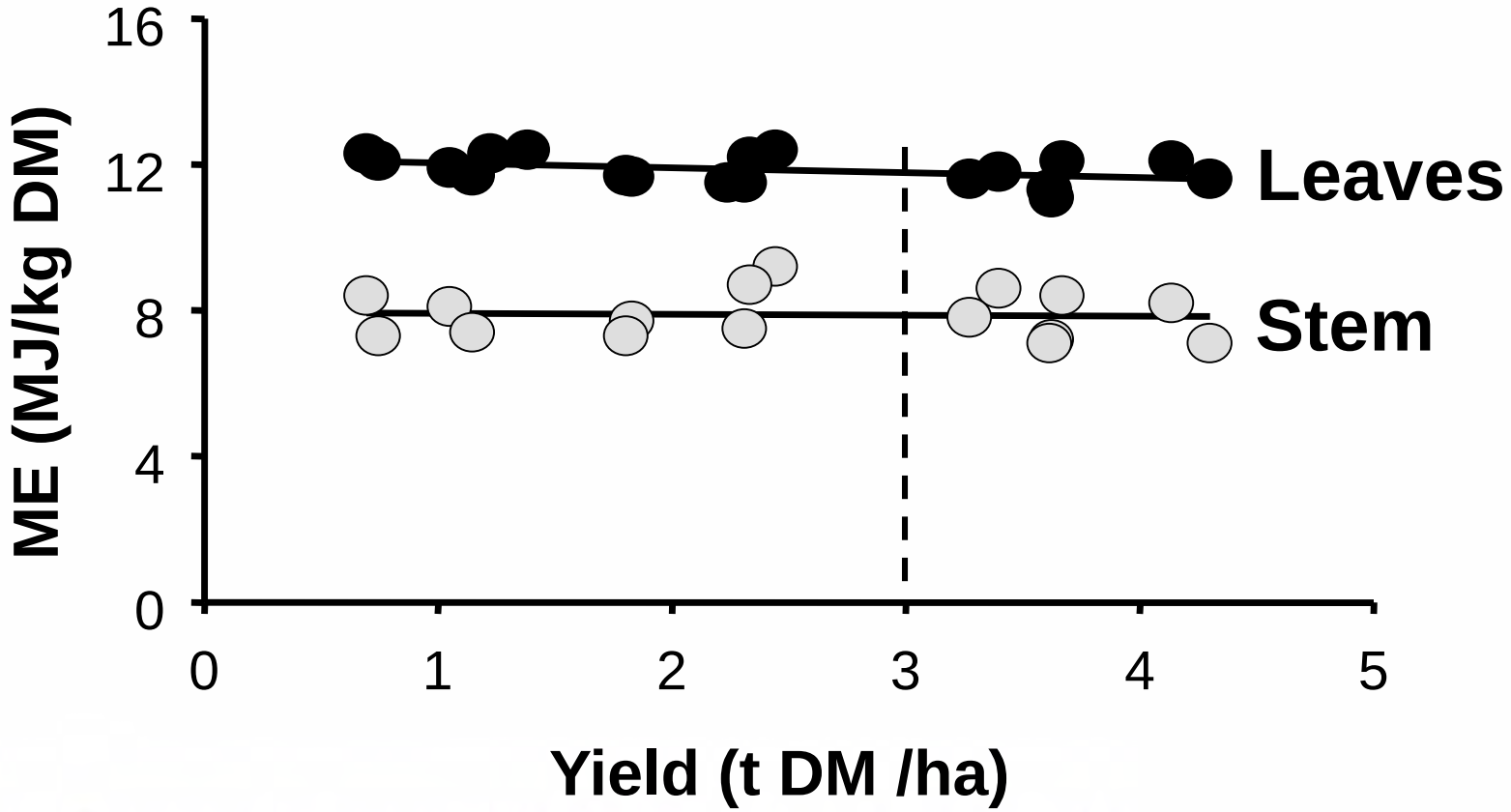
Photo: Doug Avery, Bonavaree

Relationship between LWt production and feed consumed



T Ryan-Salter unpublished

Metabolisable energy of lucerne



Brown & Moot 2004

Seasonal grazing management

Early autumn (Feb-April)

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

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

Landscape farming – Bog Roy Station

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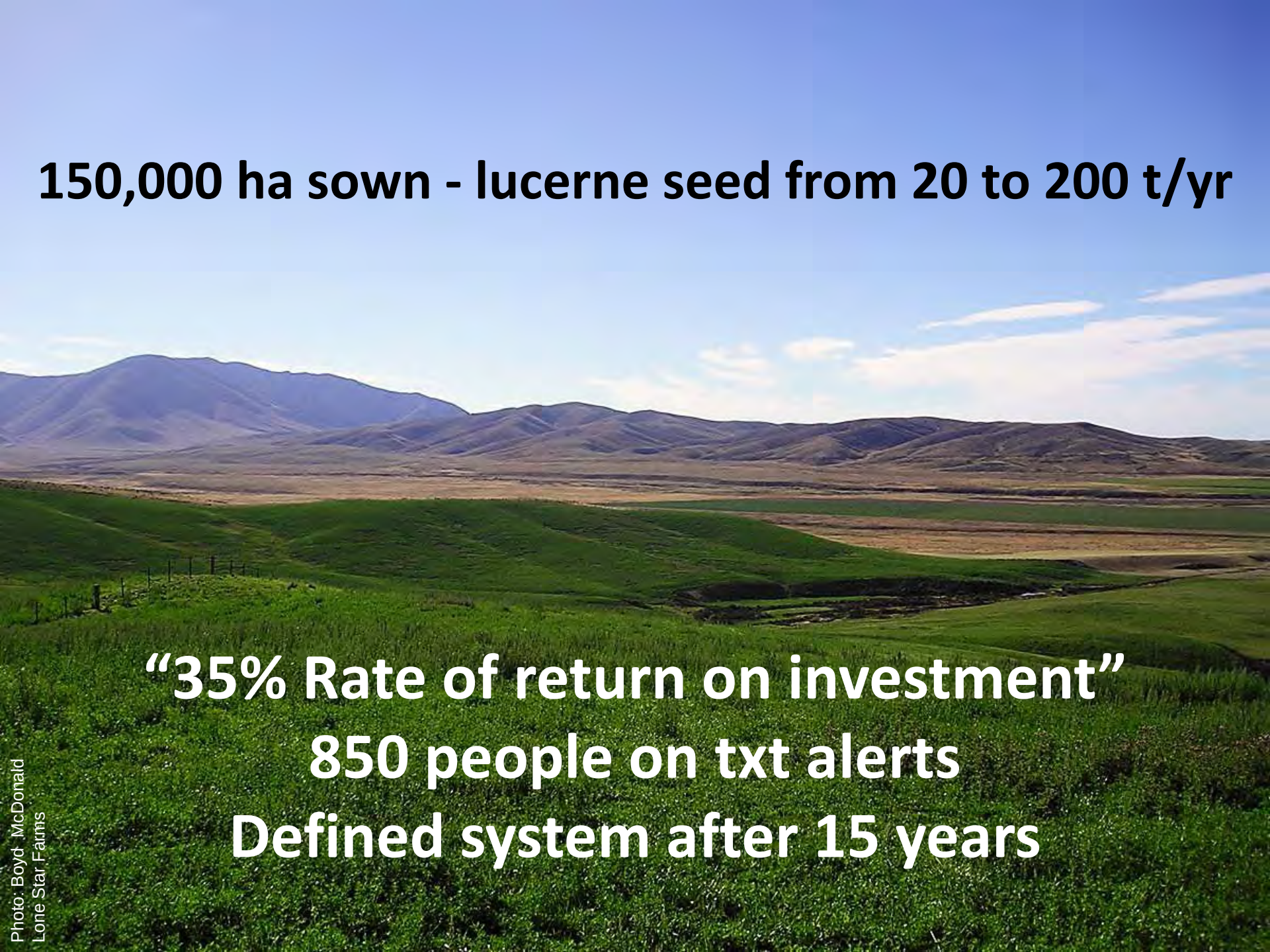
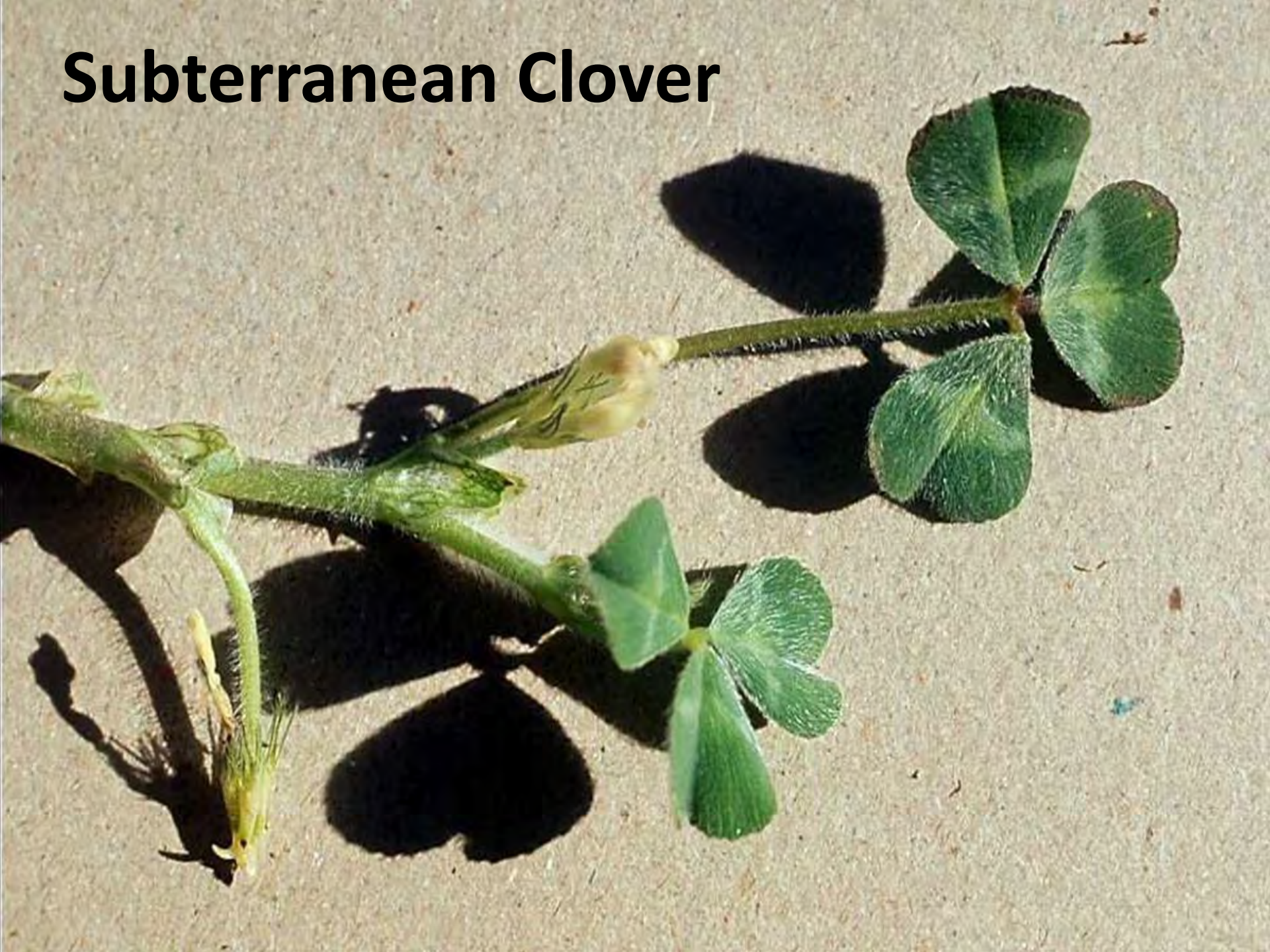
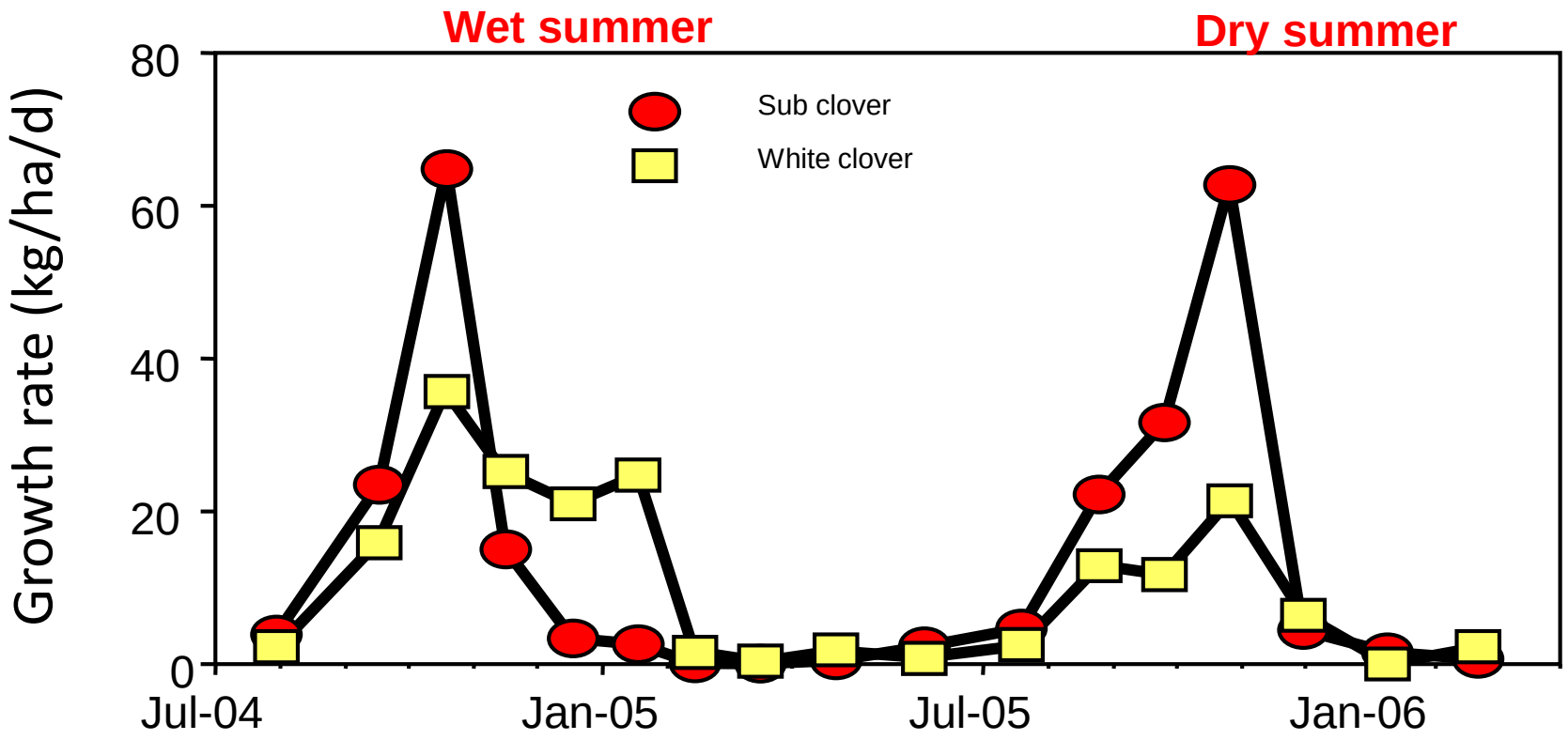

150,000 ha sown - lucerne seed from 20 to 200 t/yr
“35% Rate of return on investment”
850 people on txt alerts
Defined system after 15 years
Photo: Boyd McDonald
Lone Star Farms

Subterranean Clover

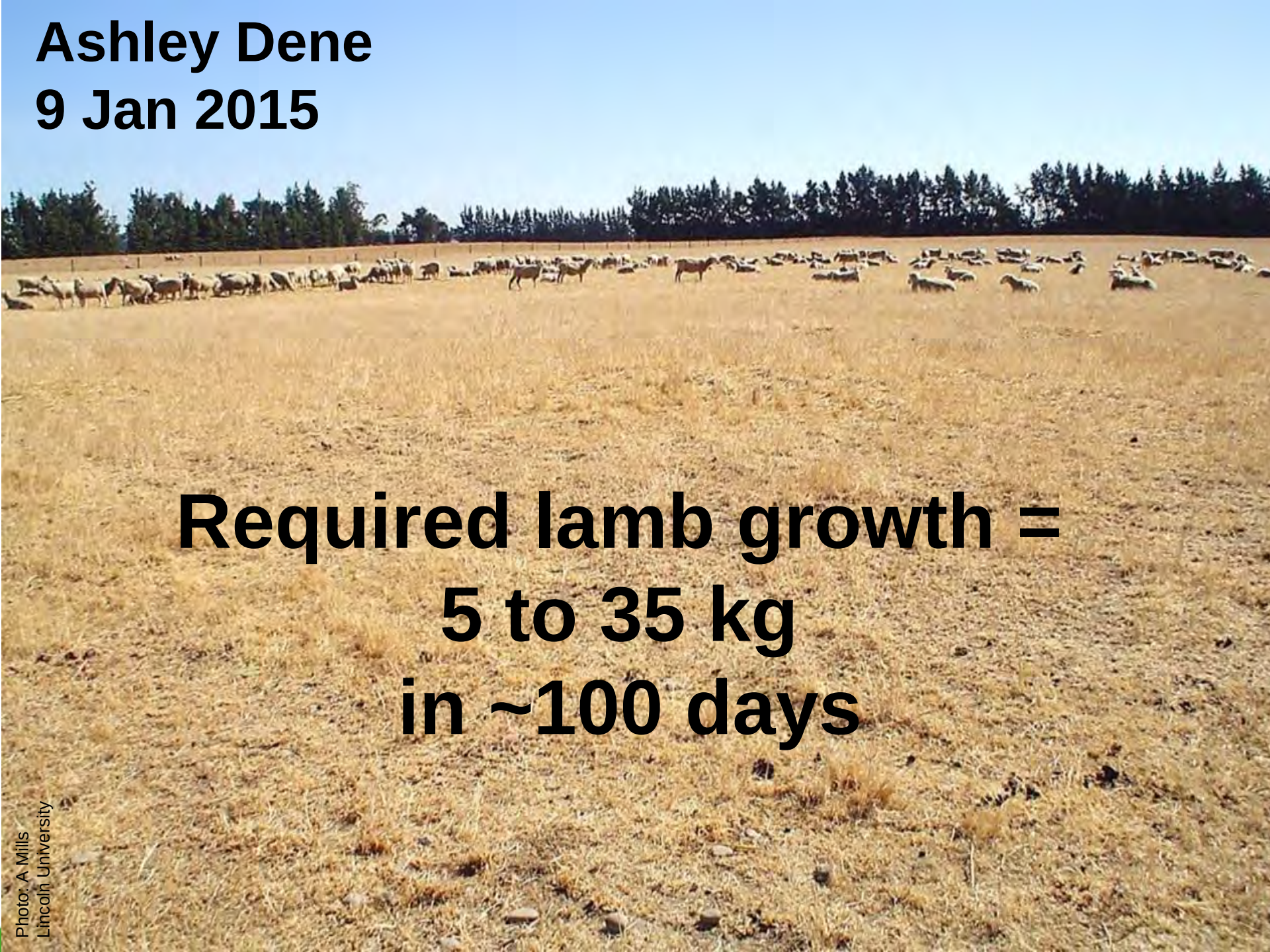


Seasonal clover growth

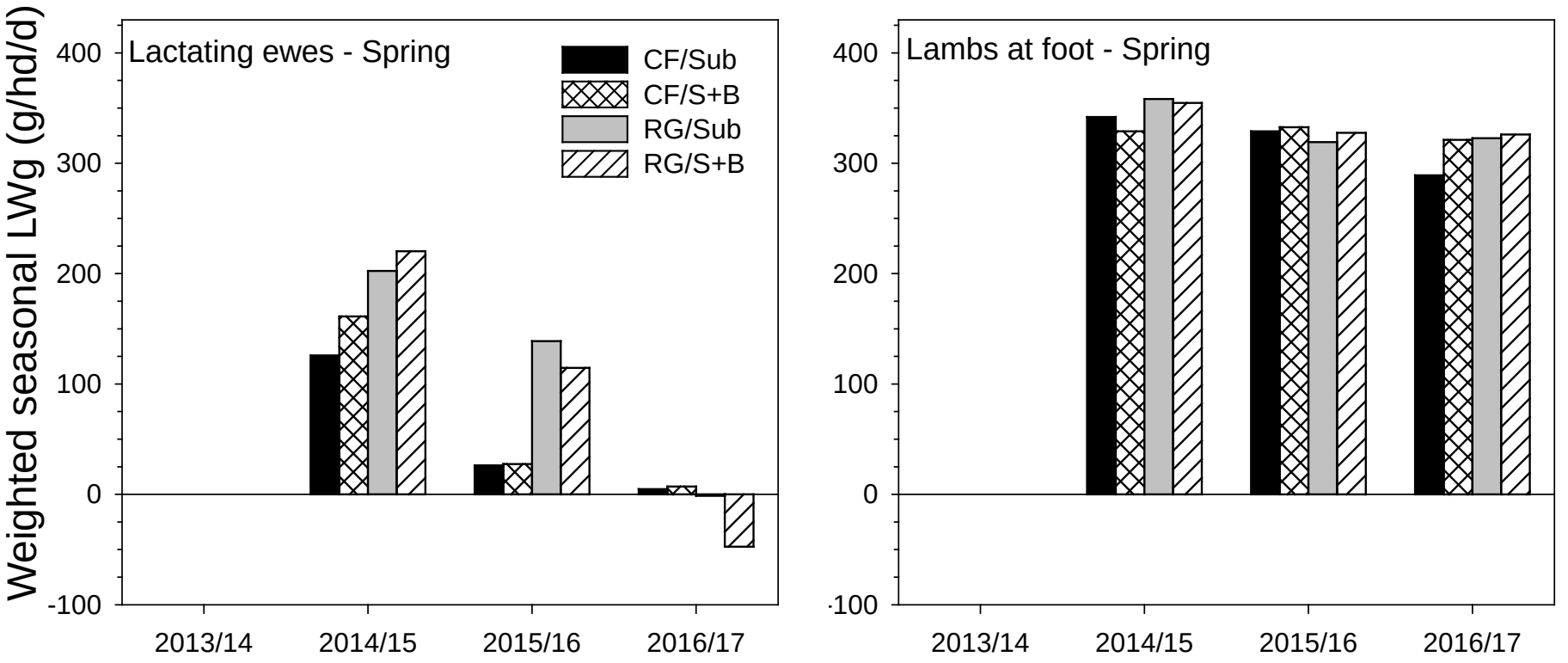


Brown *et al*. 2006

Sub clover dominant pasture 8 Oct 2015


Ashley Dene
9 Jan 2015
Required lamb growth =
5 to 35 kg
in ~100 days
Photo: A Mills
Lincoln University

MaxAnnuals



MaxAnnuals

Total Annual LWt production (kg LWt/ha)

Pasture	2013/14*	2014/15	2015/16	2016/Feb 2017
CF/Sub	388	358	396	492
CF/S+B	383	367	415	538
RG/Sub	352	423	603	528
RG/S+B	322	412	569	485
Mean	361	391	496	511
SEM	26.8	18.5	75.7	22.3
P	ns	ns	ns	ns

* = early close for reseeding.

Sub clover

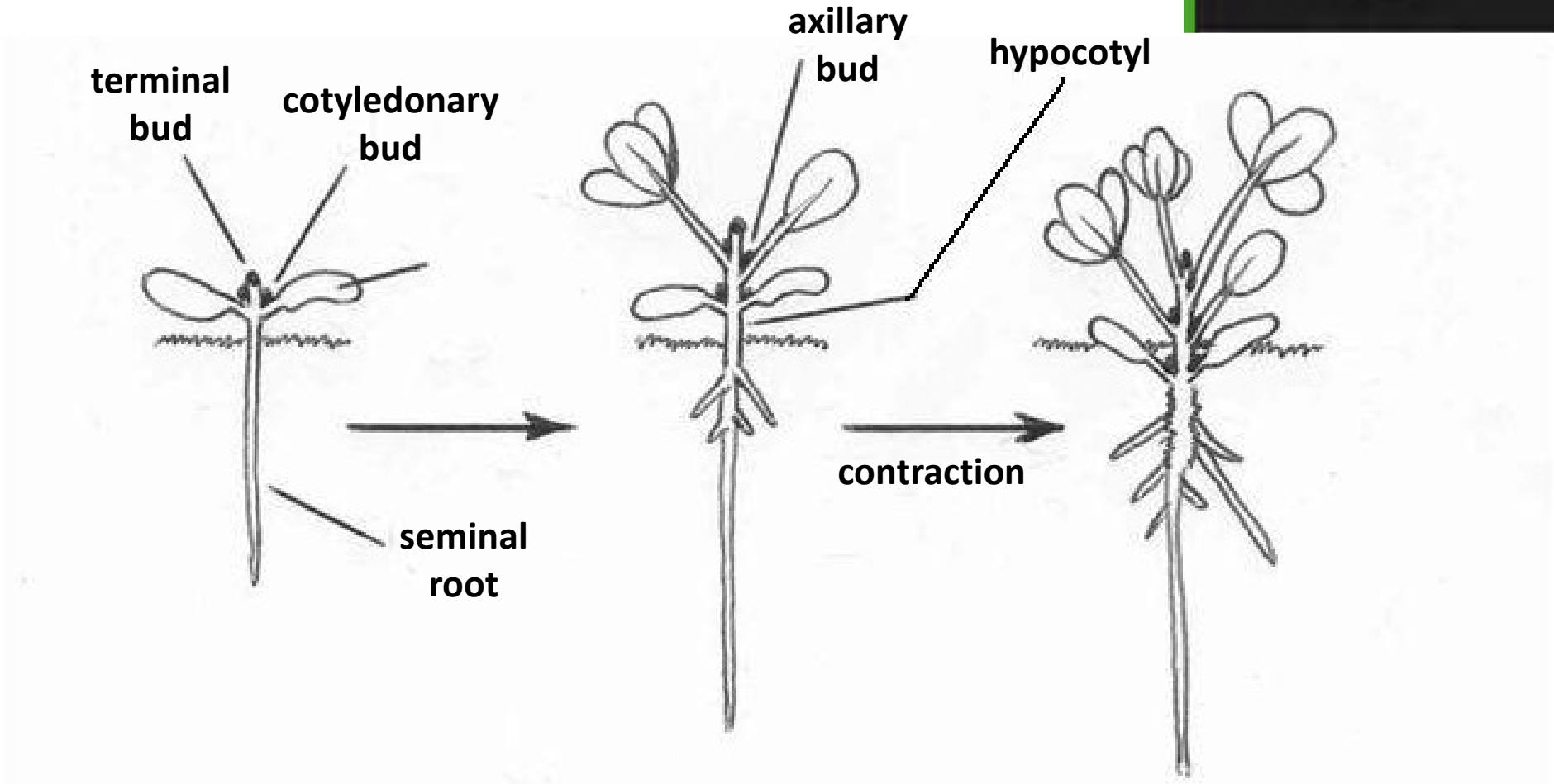
- **Best adapted legume for >4M ha of dryland in NZ.**
- **Environment is defined by the duration of the summer dry season rather than rainfall.**

- **Sub clover will thrive where:**
  - **white clover fails to persist**
  - **volunteer annual clovers are common (cluster/striated)**
  - **Olsen P >10, soil pH >5.4**

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

Seedling Development



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Thomas 2003

Photo: KM Pollock
Lincoln University

Sub 4 Spring

- Limited NZ knowledge with “newer” cultivars.
- Interpret Australian results for NZ environments.
- Allow for climatic and site variation by sowing mixtures of sub clover cultivars.
- Sow 10 kg seed/ha total sub clover
  - 5 kg/ha of each cv in autumn.

Sow complementary mixtures

- “Older” proven with a “newer” cultivar
- Mid flowering with late flowering

Lucas *et al.* 2015

Suggested Combinations

- 5-6 month dry
  'Woogenellup' +'Narrikup'
- 4 month dry
  'Denmark' + 'Narrikup'
- 3 month dry
  'Denmark' + 'Leura'
- Wet soils –
  add 'Napier'
- Early spring feed
  add 'Antas' pH>6.0

- Hardseededness of 1-2 preferred: more information needed

Lucas *et al*. 2015

Direct drill before rain

Initial population for seed build up

Autumn Management in later years

(200 seedlings/m^2 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

Photo: Derrick Moot
Lincoln University

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Lincoln University
9/3/2017

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Lincoln University
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Californian thistle

Photo: Derrick Moot
Lincoln University


Photo: Derrick Moot
Lincoln University
Yarrow


Photo: Derrick Moot
Lincoln University
Twitch


Photo: Derrick Moot
Lincoln University


Photo: Derrick Moot
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Photo: Derrick Moot
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Photo: Derrick Moot
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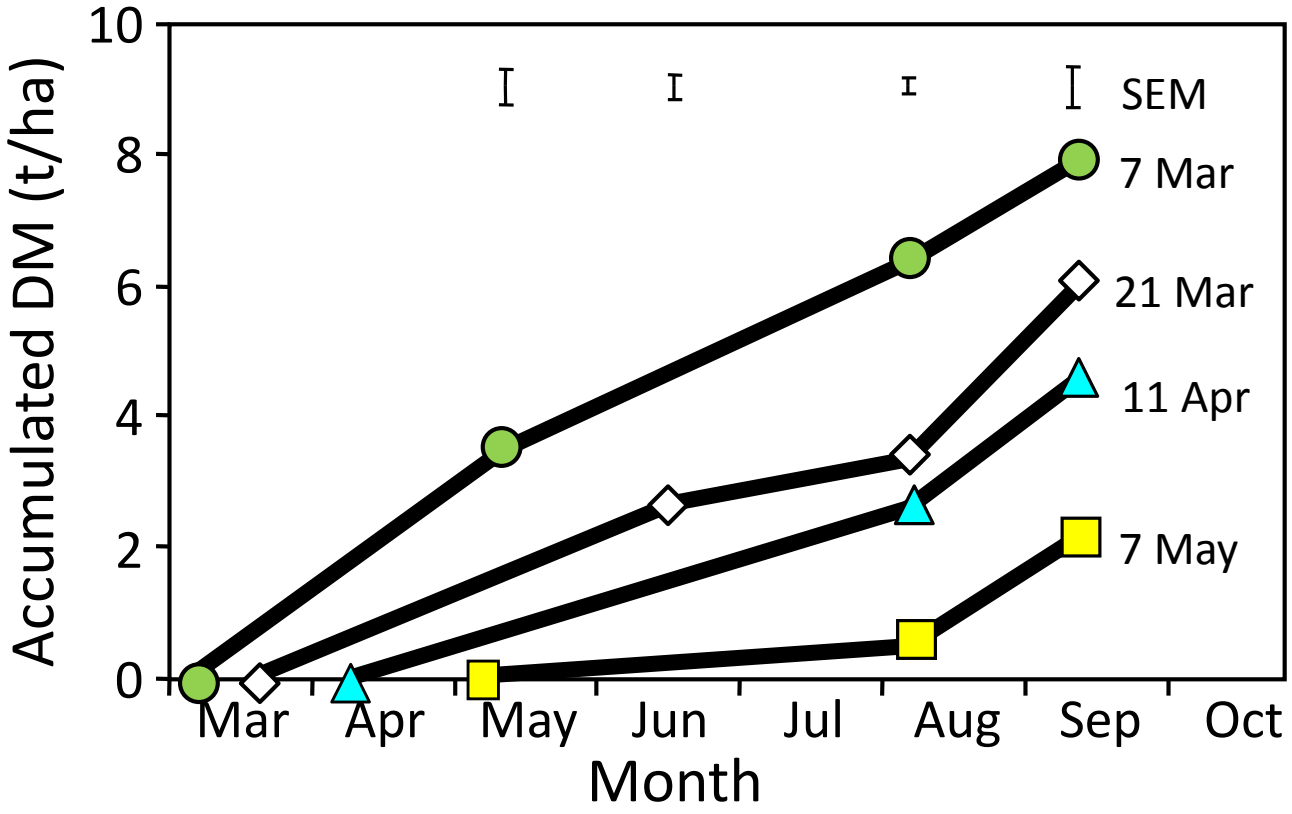
seedling

Dry matter yields



Takes several years to build seed reserves

Costello & Costello 2003

Pasture Mix

- 10 kg subterranean clover
  –early and late flowering cultivars
- 1 kg cocksfoot

- Hill country = 10 kg/ha sub. alone
- Or manage for the sub that is there

‘Cefalu’ arrowleaf

‘Bolta’ balansa

‘Prima’ gland

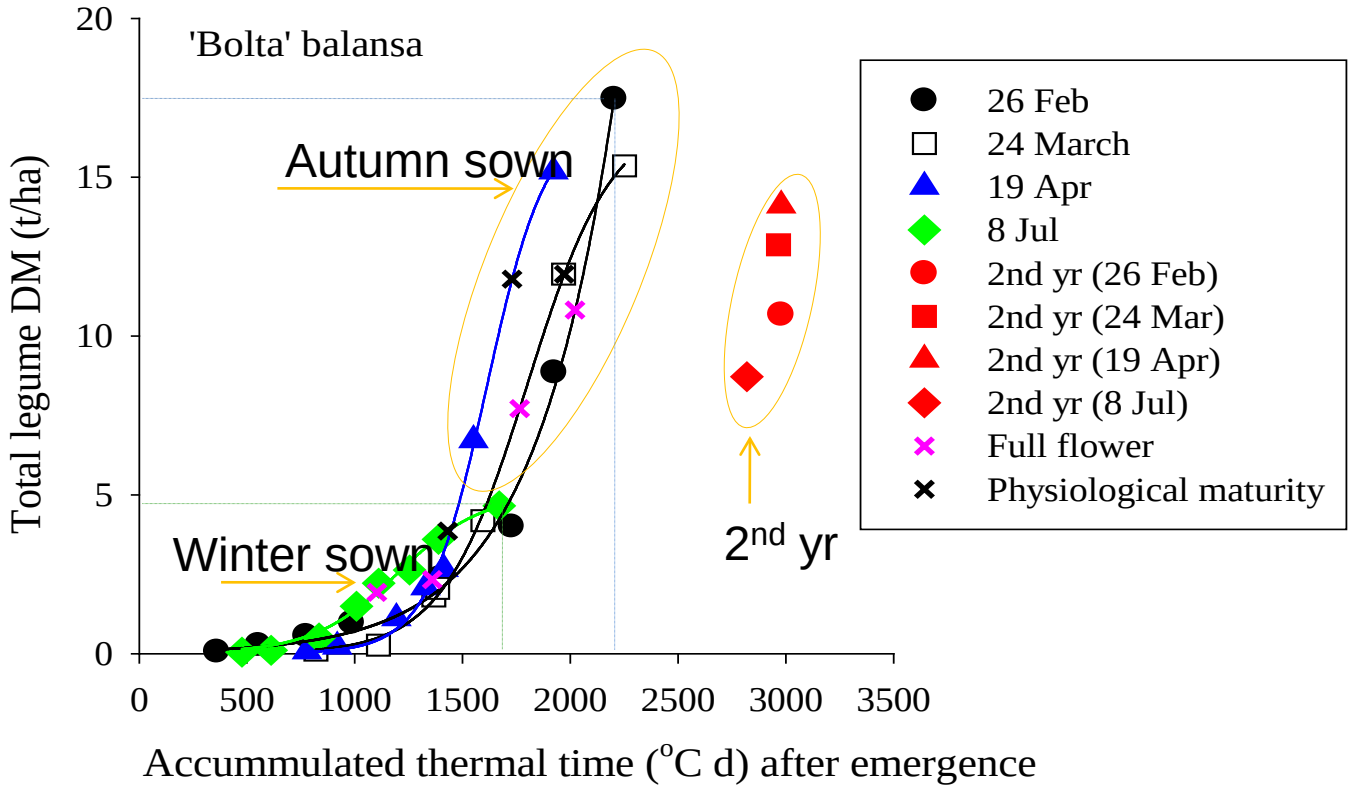
‘Mihi’ Persian

Nori *et al.* 2015a; 2015b

Establishment of annual clover
Important to reseed !!

Photo: DJ Moot
Lincoln University

Total dry matter production (t/ha)



Dry matter production (t/ha)

	1st yr (Total)	2nd yr (Full flower)
Species	**26-Feb-10**	**Mean**
‘Cefalu’ arrowleaf	9.4	0.5 **Hardseed!!**
‘Bolta’ balansa	17.5 **Wohoo!!**	11.6
‘Prima’ gland	7.8 **Matured too quickly!!**	2.9
‘Mihi’ Persian	12.5	8.3

Seed maturity

‘Cefalu’ arrowleaf

‘Bolta’ balansa

‘Prima’ gland

‘Mihi’ Persian

Nori *et al.* 2015b

Reduce the risk

- Legumes provide nitrogen for water use efficiency
- Annual legumes grow earliest in spring
- Sub clover is often dormant in dryland pastures
- Managing the seed bank to regenerate annuals
- Top flowering clovers – more difficult to maintain
- Lucerne is your first option

Start **planning** your legume option - now

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Website

Handouts & presentations

FAQs

Direct link to Blog

www.lincoln.ac.nz/dryland

Facebook: @DrylandPasturesResearch

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