Dryland pastures

- agronomy and grazing management

Dr Derrick Moot
Professor of Plant Science
Experiment site
Growth rates (2 year means)

<table>
<thead>
<tr>
<th>Month</th>
<th>Growth rate (kg/ha/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>30</td>
</tr>
<tr>
<td>30</td>
<td>60</td>
</tr>
<tr>
<td>60</td>
<td>90</td>
</tr>
<tr>
<td>90</td>
<td>120</td>
</tr>
</tbody>
</table>

I+N: 21.9 t/ha
I-N: 9.8 t/ha
D+N: 15.7 t/ha
D-N: 6.3 t/ha

Source: modified from Mills et al. 2006
Pasture Growth Rates – 2 yr mean

Source: modified from Mills et al. 2006
Winter $\Rightarrow$ temperature response
The Nitrogen gap

Source: Mills et al. 2009
Summer ⇒ moisture response
Total rain = 520 mm

Source: modified from Mills 2007
The Nitrogen gap

Source: Mills et al. 2006
‘MaxClover’

Rg/Wc
Lucerne
CF/Sub
CF/Balansa
CF/Cc
CF/Wc
‘MaxClover’ Total DM Yields
(to 30 March 2011)

Source: Moot 2012
Sub clover
Balansa clover
Caucasian Clover
Seasonal clover growth

Growth rate (kg/ha/d)

Source: modified from Brown et al. 2006
Seasonal grass growth

Growth rate (kg/ha/d)

Source: Brown et al. 2006
RG/Wc pastures

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

Spring

Summer
Year 4

- Annual grasses
- Taprooted dicot weeds

Photo: M. Smith, Lincoln University
Photo: A. Mills, Lincoln University
Lucerne pastures

Spring Year 5

Spring Year 7
Spring WUE: legume = (nitrogen)

Source: Moot et al. 2008
Nitrogen deficient pasture

1000 kg N/ha

Photo: D. Moot
Lincoln University
Nitrogen fertiliser use

Source: New Zealand Fertiliser Manufacturers' Research Association 2009
Water and nitrogen = ryegrass
Clover content & milksolids production

Source: Cosgrove, 2005
Sheep prefer 70% legume, 30% grass
Daily lamb live weight gains in summer/autumn when intake was maximised in experiments using ryegrass & white clover pastures as the control.

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

(Source: P. Kemp modified from Kemp et al. 2010)
• 65 – 437mm
• grazed in common, 6-7 times per year
• 7-10 day measurement interval
• 6 years
Annual yield - irrigated

<table>
<thead>
<tr>
<th>Plant</th>
<th>1997/98</th>
<th>1998/99</th>
<th>1999/00</th>
<th>2000/01</th>
<th>2001/02</th>
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<tbody>
<tr>
<td>Chicory</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>12</td>
</tr>
<tr>
<td>Lucerne</td>
<td>30</td>
<td>25</td>
<td>20</td>
<td>15</td>
<td>12</td>
</tr>
<tr>
<td>Red clover</td>
<td>20</td>
<td>15</td>
<td>10</td>
<td>5</td>
<td>8</td>
</tr>
</tbody>
</table>

Source: Brown et al. 2005
Annual yields - dryland

<table>
<thead>
<tr>
<th>Growth season</th>
<th>Year</th>
<th>Yield (t DM/ha)</th>
<th>LSD</th>
</tr>
</thead>
<tbody>
<tr>
<td>97/98</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>98/99</td>
<td>10</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>99/00</td>
<td>20</td>
<td>20</td>
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</tr>
<tr>
<td>00/01</td>
<td>30</td>
<td>30</td>
<td></td>
</tr>
<tr>
<td>01/02</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Source: Brown et al. 2005
Persistence

Botanical composition (%)

LSD

Chicory

Lucerne

Red clover

Growth season

Source: modified from Brown & Moot 2004
Ryegrass/clover vs. Lucerne
### Resistance to Pests and Diseases

<table>
<thead>
<tr>
<th>Cultivar</th>
<th>Dormancy</th>
<th>BGA</th>
<th>PA</th>
<th>SAA</th>
<th>BW</th>
<th>SN</th>
<th>PRR</th>
<th>VW</th>
<th>LD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grasslands Kaituna</td>
<td>I</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
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<tr>
<td>Grasslands Otaio</td>
<td>I</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>S</td>
</tr>
<tr>
<td>Grasslands Torlesse</td>
<td>D</td>
<td>HR</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>-</td>
<td>MR</td>
<td>-</td>
</tr>
<tr>
<td>P54Q53</td>
<td>D</td>
<td>MR</td>
<td>MR</td>
<td>MR</td>
<td>HR</td>
<td>HR</td>
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<td>-</td>
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<tr>
<td>P54V09</td>
<td>D</td>
<td>-</td>
<td>HR</td>
<td>R</td>
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<td>HR</td>
<td>-</td>
<td>-</td>
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<tr>
<td>Runner</td>
<td>D</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>R</td>
<td>-</td>
<td>S</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Wairau</td>
<td>SD</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>WL 325HQ</td>
<td>I</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>R</td>
<td>MR</td>
<td>R</td>
<td>-</td>
<td>-</td>
</tr>
</tbody>
</table>

**Legend:**
- **BGA** = Blue-green aphid
- **PA** = Pea aphid
- **SAA** = Spotted alfalfa aphid
- **BW** = Bacterial Wilt
- **SN** = Stem nematode
- **PRR** = Phytophthora root rot
- **VW** = Verticillium wilt
- **LD** = Leaf diseases
- **D** = Dormant
- **SD** = Semi-dormant
- **HR** = 50%+ resistant
- **R** = Resistant = (31-50%)
- **MR** = 16-30%
- **S** = Susceptible
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
• Low palatability
• Low production
• Low legume

Source: Kearney et al. 2010
Lime and Fertiliser Application

Lime 3-5 ton/ha
Fertiliser 250-500kg/ha

Source: Kearney et al. 2010
Autumn Spraying

- Timing is Critical
- Most important tool
- Glyphosate, granstar, penetrant

Key Results

- Conserve soil moisture
- Kill mass root systems

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
Lucerne root
~8 months after sowing
> 1.5 m length
Sown: 21/11/2007
Photo taken: 1/11/2010
Styx Station

Source: Kearney et al. 2010
Pasture growth

Source: Kearney et al. 2010
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

Never lamb on or set stock lucerne
Vegetative growth

Above ground growth rate (kg DM/ha/d)

Mean temperature (°C)

Source: Moot et al. 2003
38 days resting
4 days grazing

25 days resting
3 days grazing
Partitioning to roots

Tap root dry weight (t/ha)

- 42-day
- 28-day

(Source: Moot et al. 2003)
Doug and Fraser Avery “Bonavaree”
Seasonal grazing management

*Spring/summer (Nov-Jan)*

- Priority is stock production (lamb/beef/deer)
- Graze 8-12 weeks solely on lucerne
- 5-6 paddock rotation stocked (7-10 days on)
- 10-12 ewes plus twin lambs per hectare
Resident pasture

Lucerne mixture

‘Bonaveree’ Marlborough
July 2010
Maximize reliable spring growth – high priority stock
Rotation 1 Pre-graze
Plot 1 (21/9/07)
2.3 t DM/ha
20-25 cm tall
Rotation 2 Pre-graze
Plot 1 (2/11/07, 38 d)
2.9 t DM/ha
35-40 cm tall

Photo: M. Smith
Lincoln University
Grazing Rotations at Lincoln University

Date

DM Yield (t/ha)

Monthly rainfall (mm)

Source: Moot & Smith, 2012
Estimating yield from height

\[ y = 79.7x \]

Source: Moot unpublished
Metabolisable energy of lucerne

Source: Brown & Moot 2004
Utilization of lucerne herbage

<table>
<thead>
<tr>
<th>Yield (t DM/ha)</th>
<th>Utilization (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>100</td>
</tr>
<tr>
<td>1</td>
<td>80</td>
</tr>
<tr>
<td>2</td>
<td>60</td>
</tr>
<tr>
<td>3</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>20</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
</tr>
</tbody>
</table>

Source: modified from Brown & Moot 2004
Rotation 4 Pre-graze

Plot 6 (28/2/08) **2.0 t DM/ha produced in 51 d**

Post-graze (4/3/08) **0.6 t DM/ha**

UTILISATION = **70%**
Creating a net of opportunity

Any autumn rain grows high quality feed
Seasonal grazing management

Late autumn/winter (May-July)

• hard grazing once growth stops (frost)  
  ⇒ decrease aphid population

• spray for weeds 10-14 days after winter graze

- grazing/spraying early July
- nodes developing at low temperatures
3. Animal health

- **Redgut**: problem on high quality feeds – fibre
- **Bloat**: cattle more than sheep – capsules
- **Na def.** (0.03%): salt licks/fence-line weeds/pasture
- Require 0.11% Na - sheep/beef/dairy (13%)
3. Animal health (cont’d)

- **Clostridial bacteria**: vaccinate with 10 in 1
- **Cobalt**: vitamin B12 injection
- **Worm haven**: Camping on small area – river edge?
- **Leaf spot in autumn**: avoid flushing on older lucerne
  - new regrowth or tops only are O.K.
Forest conversion 100 000 ha
Ewe hoggets grown on lucerne 54 kg ave
Corriedale 2th flushed on wilting lucerne
Lucerne (is not grass!!!)
- flushing at Bonavereee

Photo: D. Avery
Bonavereee

04.03.2009
4. Fertilizer

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

• 50% K super = 80 kg/ha/t DM removed

Or

• KCL = 40 kg/ha/t DM removed + P and S from super
5. Weed Control

Bad weeds = grasses and tap rooted flat weeds

Never set stock in spring

⇒ stand open for summer annual invasion control: herbicide before July 1

K super if conserving (soil K > 6)
Waterlogged

‘Bonaveree’ Marlborough
July 2010

Photo: D. Avery
Redrill poorly established areas
Close up of a prairie grass and lucerne mixture

‘Bonaveree’ Marlborough
July 2010
‘Tama’ annual ryegrass overdrilled into runout lucerne (12 yrs)
‘Tama’ annual ryegrass overdrilled into runout lucerne (12 yrs)
- Close up -
Lucerne + cocksfoot – Haka Valley
Lucerne + Prairie grass
Diverse drought-proofed landscape

SI Farmer of the Year 2010
Conclusions

• Aim to transform farms to be economically, environmentally and socially resilient.

• Require regionally specific technical solutions and ongoing extension.

• Nitrogen from legumes is the key to improve pastoral water use efficiency.

• Lucerne and herbs have a key role to play in pastoral farming for deer, beef, and sheep.
Acknowledgements

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• Lincoln University
• MAF Sustainable Farming Fund
References


