High Country Forage Improvement Project

Professor Moot gave this presentation at:
Christchurch
Danseys Pass
On:
13 March 2012 16 March 2012
Commenced spring 2011

Professor Derrick Moot
Dr Alastair Black - Pastures
Dr Jim Moir - Soils
Mr Dick Lucas – High country
Dr Keith Pollock - Technician
PhD: Saman Berenji, Travis-Ryan Salter
Honours: Lucy Murray, Scott Harvey
Farmer coordinator: Denis Fastier
Complimentary student research

- Production and persistence of legume species in unimproved hill and high country soils – Lees Valley, Ashley Dene, Glenmore
- Enhancing legume establishment and growth in these regions (interactions of soil pH, Al, and P).
- Understanding BNF in these regions – efficacy and fitness
- Genotyping indigenous rhizobia strains
- Ecology of oversowing, and resident annual legumes
<table>
<thead>
<tr>
<th>Location</th>
<th>Soil depth (cm)</th>
<th>pH</th>
<th>Olsen P (µg/ml)</th>
<th>Al (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lees Valley</td>
<td>0 -15</td>
<td>5.2</td>
<td>12</td>
<td>15.1</td>
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<tr>
<td>Ashley Dene</td>
<td>0 -7.5</td>
<td>5.2</td>
<td>34</td>
<td>4.2</td>
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<tr>
<td>Glenmore</td>
<td>0 -7.5</td>
<td>5.1</td>
<td>15</td>
<td>8.9</td>
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</tbody>
</table>
At Lincoln University – rapid growth responses
At Ashley Dene
(7/02/2012)
+ Rhizobia

Control

Ashley Dene - 9/03/2012
Merino forage projects

Lake Heron
Sawdon
Glenmore
Simon’s Hill
Bog Roy
Omarama
Mt Grand
1) Can legumes be established economically in undeveloped tussock lambing blocks?
   • Nitrogen (20 kg N/ha) vs. super (110 kg/ha)

2) Caucasian clover survives – how to make it thrive?
   • Lime (0, 5 t/ha) vs. super (0, 100, 200, 400 kg/ha)
Duncan Enviro Drill
Cocksfoot and Caucasian clover seedlings 7/3/12
Resident Caucasian clover on 28/02/12
Future research

• Growth, development and survival of species

• Cross rates of additional fertilizer treatments

• Timing of introduction of grass species
  - compliment nitrogen fixing
  - suppress reinvasion of browntop
Sawdon – Snow Loxton

Can lupins provide a productive feed source for merinos? Still to be answered.......

• Ewe fertility

• Lamb growth rates – pre and post grazing

• Lupin grazing preference, pasture composition, nutritive value

• Lupin/perennial grass balance
Sawdon grazing experiment

Paddock divided into four grazing blocks.

- Start 17/12/2011
- Graze 14 days
- 42 day spell
- Lambs weaned 10/02/12
- Lupin DM yield and component nutritive value
Sawdon – ~ 10 t DM/ha (7 yr)
High utilization at low lupin density – behavioural?

Only 5% other sps – dead, trampled.

Grazing preference - flowers and green pods
Sawdon

*Live weights on lupin vs. lucerne*

Graph showing live weights (kg) for lucerne and lupin ewes and lambs from 17 Dec 2011 to 10 Feb 2012.
Live weights on lupin vs. lucerne

- Weight gains over total trial time (55 days)
  - Lupin ewes lost 3 kg (-55 grams/day)
  - Lupin lambs gained 9 kg (+164 grams/day)
  - Control ewes gained 5 kg (+91 grams/day)
  - Control lambs gained 12 kg (+218 grams/day)

“...I predict that the lupin result will still be above the average, and the control mob on lucerne is outstanding. A couple of ewes were staggering around with lupinosis, but otherwise stock were clean as a whistle, and blooming.” – Denis Fastier
Can legumes be successfully established through zero cultivation on previously unimproved land?

Double sprayed – autumn and spring
Expt 1: 2 t/ha lime - 3 species, 3 drill types
Expt 2: 4 t/ha lime - 3 species, 3 drill types

Single spray – spring
Expt 3: - 3 species, 3 drill types
Expt 4: no spray – 3 species, 3 coulter types
Glenmore

Browntop dominated pasture

Also
- Poa pratensis
- Haresfoot trefoil
- Sweet vernal
- Suckling clover
- White clover
- Hawkweed
3 Coulter types
Trial site – drilled 15 Nov 2011
Soil testing

A hole 3 m deep and sampled every 0.5 m. pH increases and aluminium decreases after first 0.5 m
## Glenmore Station soil test results (Nov 2011)

<table>
<thead>
<tr>
<th>Soil depth (cm)</th>
<th>pH</th>
<th>Al (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0-5</td>
<td>5.1</td>
<td>8.2</td>
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<tr>
<td>5-10</td>
<td>5.3</td>
<td>4.9</td>
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<td>10-20</td>
<td>5.6</td>
<td>4.1</td>
</tr>
<tr>
<td>20-30</td>
<td>5.5</td>
<td>4.9</td>
</tr>
</tbody>
</table>

## Lime application: Autumn 2011

<table>
<thead>
<tr>
<th>Lime (t/ha)</th>
<th>Soil depth (cm)</th>
<th>pH</th>
<th>Olsen P (µg/ml)</th>
<th>Al (mg/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7.5</td>
<td>5.1</td>
<td>15</td>
<td>8.9</td>
</tr>
<tr>
<td>2</td>
<td>7.5</td>
<td>5.6</td>
<td>32</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>7.5</td>
<td>5.8</td>
<td>48</td>
<td>1.5</td>
</tr>
</tbody>
</table>
Effect of P and Lime treatment on Al level

<table>
<thead>
<tr>
<th>Lime rates (t/ha)</th>
<th>Exchangeable Aluminium (mg kg⁻¹ soil)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>7.6</td>
</tr>
<tr>
<td>0.5</td>
<td>5.95</td>
</tr>
<tr>
<td>1</td>
<td>2.85</td>
</tr>
<tr>
<td>2</td>
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<td>4</td>
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<tr>
<td>0</td>
<td>0.365</td>
</tr>
<tr>
<td>0.03</td>
<td>0.03</td>
</tr>
<tr>
<td>0.03</td>
<td>Toxic</td>
</tr>
</tbody>
</table>

The graph illustrates the decrease in exchangeable aluminium levels as lime is added to the soil. The control shows a higher level of aluminium, while lime treatments significantly reduce it. Lime rates of 2 and above are considered toxic.
Glenmore

A range of establishment success

• kill the browntop
• Species – sowing rate, growth form, growth rate, inoculation
• Drill type – depth of sowing
• Variable soil – yellowing of leaves
Large variation- lucerne
Caucasian clover
Lupins
No Lime - Lucerne
Glenmore

Success - but can we get more consistency?
The effect of Nitrogen source and lime rates on root DM of lucerne.
The effect of Nitrogen source and lime rates on shoot DM of Caucasian clover.
Future research

**How do we get greater consistency?**

- *Resow failed areas – water logging?*

- *Monitor lime effects in Expts 1 + 2.*

- *Continue coulter development*

- *Spray new area – sow lucerne and Cc with low rates of lime (0, 0.5, 1 t/ha) + inoculant*
Simons Hill – Denis Fastier

Establishing Caucasian clover in AOSTD country with a High Country, No Spray, Direct Drill
Peels back competition and leaves tilth
Improvements over conventional AOSTD
New technology for slow to establish legumes
4 Fert types and 3 rates at establishment
A sunny and dark site

Results:
No match for conventional double spraying
Sunny site swamped by Haresfoot trefoil
Dark side swamped by white clover
Balance of the sunny block was hard grazed, aerial sown with annual clovers and trampled.

200 kg 30% sulphur super

0.5 ha direct drilled trial of these species on easier part of block

Sowing date 24\textsuperscript{th} Feb, 2012

Question still remains – Did the season beat us? Was it atypical?

What role can lupins play?
Quantify benefits of lucerne over resident

• Monitoring lucerne growth in paired samples vs. unimproved.
• Experimental oversowing of annual legumes
Bog Roy- Lucerne paddock rotation

On-farm paddock yields and utilization.

Mobs 4, 5 & 6

Dry Matter Yield (kg/ha)

Pre graze  □ Post graze
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
Bog Roy

Future research:

• Improve lucerne grazing utilization – make money
• Flowering and reseeding of annuals - survive
• New irrigation block – make money!??
Omarama Station – Richard Subtil

Aerial sowing annual clovers 30 ha on hill

- Sown 8/3/12 Fixed wing, 400 kg Super
- Hard grazed pre sowing and trampled post sowing.
- 4 kg Bolta + Frontier Balansa, 2 kg cocksfoot.
- Moist E vs. dry N & W slopes
Hard grazed
Mt Grand Station – Evan Gibson

Establishing and utilizing annual clovers

- Aerial over-sowing, Bolta balansa,
- Balansa hay (with seed) baled and fed out on steeper slopes
Mt Grand Station

Hard early Spring Grazing to open up weed competition.
Mt Grand Station

Flowering, 30th Nov.
Mt Grand Station

Cottage paddock - Bolta balansa clover trial

• Even with a reasonably cool and dry spring the clover leapt out of the ground smothering any competition and was a foot tall and starting to flower by labour weekend, 24th October.

• Flowering and growth continued until at least the end of November when the plants were around 80 cm tall and a mass of flowers at different stages.

• The ground on both the grazed and baled parts of the paddock were littered with seed and the hay bales have a lot of seed in them also.
Mt Grand Station

60 x 230 kg bales, mowed 22nd Dec, raked 26th Dec, photo taken 27th Dec.
Mt Grand Station

Second generation seedlings 19th Jan 2012.
Mt Grand Station

First strike (Jan) seedlings on 3rd March 2012.
Mt Grand Station

Second strike of seedlings on 3rd March 2012.
Mt Grand Station

*Bolta balansa hay bales fed out on hill country - Valley block*

Southeast and south facing – 60 ha, one third dominated by tall oatgrass.

Granule salt used for a number of years to lure stock to this less desirable face with great success but as soon as the smell of salt disappears so do the stock.
Mt Grand Station

Valley Block Hay experiment

Twins on hay and salt strips, 19th Jan 2012
Mt Grand Station

Valley Block Hay experiment

Jan-Feb 2012, every second or third day, a hay bale from our Cottage paddock, Balansa clover trial was rolled down the steep S face spreading feed and seed as it went.

In Evan’s words “… cut two of the four strings and proceeded to push the bale off the back of the truck and over the edge of the track and sat back watching (and smiling) as they would roll away down the face gathering speed in a cloud of dust, straw and seed until the rpm would get too great and the two remaining strings would be shaken free and the bales pretty much exploded. I would then walk down the hay bales path hand spreading 9 -10 kg of granule salt over the tall oat grass to encourage the stock to return and bare the strip to hopefully enable the bales seeds a chance to strike”.

After five or six bales some stock pretty much stayed on the face waiting for their next delivery.
Mt Grand Station

bare ground strip two days later and seeds
Clover seedlings near top of the strip. Tall oat grass more dominant because of less salt applied.
Mt Grand Station
Valley Block Hay experiment
Mt Grand Station

Valley hay experiment

The strip coming away again, 8-3-12. (Note: Person not to give scale, he is only 3 ft tall not 6 ft)
Mt Grand Station

Annual clover trial – Patterson’s block

- 26 ha of steep sunny face @ 500-600m altitude
- Traditionally, set stocked with 200 ewes for the tupping then lambed onto through spring to early to mid January.
Mt Grand Station

**Annual clover trial – Pattersons block**

March 2011 - Grazed hard by 1400 ewes just prior to sowing. Top dressed 200 kg/ha of Maxi sulphur super.

End March - 13 ha at the eastern end of the block was over-sown. 6 kg Campeda sub clover + 4 kg Prima gland clover + 4 kg Bolta balansa clover + 1 kg Tonic plantain.

Early April 2011 - 750 2-tooths trampled in seed

Spelled until the 4th of May then 206 older ewes until the mid July.
Mt Grand Station

**Annual clover trial – Pattersons block**

Gland and Balansa clovers flowering, 31 Oct 2011

Smothered by Striated clover

Redoing 13 ha 9/3/12 ± reseeding
Conclusions

• Wide range of research across a geographically large area
• Identified farmer questions –
• Designed experiments to investigate these
• Integrated on-farm and LU research
• Early stages of data collection – promising
• Scope for introducing other interested parties
• No definitive answers – yet but.....promising
• Scope for transformational change akin to dryland
Mt Grand Station

*Cottage paddock - Bolta balansa clover trial*

• Mt Grand Stations Cottage paddock is a dry land nor-west facing paddock on an alluvial fan with approximately a 10 degree slope over most of the paddock and has a creek bed flowing through the middle of it, and with an annual rainfall of around 700 mm.

• Sown on the 24th of March 2011, 8 mm rain on the 26th and 13 mm on the 27th - a good strike.

• We sowed it ourselves using a contractors roller drill with a light cover harrow behind, it was sown at 5 kg Bolta Balansa, 1 kg Plantain and 1 kg Timothy per ha over the 5.8 ha that is cultivatable in the paddock.

• After a reasonably dry April (30 mm) a lot of competition from Shepherds purse and Poa annua was starting to impact on a fair portion of the paddock but after a skif of snow on the 17th of April and some frosts slowing growth a spray was ruled out as a option to help free up the clover so we elected not to autumn graze in favour of a hard early spring graze.

• On the 13th of September the paddock was cut into 3 blocks and 900 single ewes were run onto hard graze the pdk, they stayed here until lambing started, finishing two of the three blocks, the third block was grazed by shorn hoggets finishing on the 1st of October.

• In order to get the sheep to open up the Poa annua and shepherds purse all three blocks were grazed to the point where barely a clover leaf was evident, the paddock was then heavy rolled to enable us to mow it at a later date and a few days later I weed wiped a couple of patches of stinging nettle, then the gates were shut for clover flowering.
Mercino forage projects

Farmer's questions

1. What role are lupins able to play as a feed source for merinos?

2. What is the trade-off between full preparation and short cut methods of establishment for introducing improved pasture species?

3. How can we successfully establish Caucasian clover with cocksfoot in unimproved fragile country with zero tillage, no spray and at low cost?

4. Having developed unimproved country – has it been cost effective?

5. What is the best approach to over-sowing hill country?

6. Why is the clover on shady faces so poor performing?

7. Can livestock be used to accelerate the seed spread of annual clovers species onto steep hill country?

8. Can legumes be established in undeveloped tussock lambing blocks?

9. What role can annual clovers play on over-sown dryland high country?