Final Report to SFF

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Pasture and forage options for store lamb and beef production from South Island hill and high country.

Prepared by

Dr Derrick Moot

Professor of Plant Science

Lincoln University

New Zealand

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Project Objectives

This demonstration site provided information on pasture/forage options for intensification of hill and high country farm land. Historically this land class is less developed and adoption of new technologies for sheep and beef farmers has been limited by a lack of demonstrable benefits specific to a given geographic location.

Specific problems identified by the project team:

- Forage crops that are essential for winter feed often produce below expectations.
- Summer moisture deficits limit the duration and reliability of traditional pasture species (ryegrass/white clover).
- A lack of specific pasture/forage option data to match feed supply to demand in these environments.
- A need to increase nitrogen into the system through legume establishment and persistence or strategic N fertiliser use.

Once the demonstration site was established, project objectives have been modified to accommodate other limiting factors that have been identified:

- Soil depth and a lack of fertility affecting pasture/forage growth.
- Failure of annual clover species to regenerate the year after sowing.
- Acidic soils and aluminium toxicity reducing the growth of lucerne despite 5 t/ha lime applied 15 months prior to sowing.
- Long winter and short spring (growth) period.
- High weed invasion into experiments sown after a double spray and cultivation from native pasture.

Browntop tends to re-establish where sown species establishment is slow.

Approach

The Lees Valley Farmer's Group (LVFG) was formed in January 2005 to discuss agronomic issues related to the intensification of Lees Valley and similar farm types throughout the South Island. At this point scientists from Lincoln University were invited to discuss potential ideas for development. Together the LVFG sourced funding from the MAF Sustainable Farming Fund (SFF) to establish a demonstration site in the Lees Valley. The aim of the 10 ha research and extension site is for public discussion and debate on pasture options for intensifying hill and high country areas led by agronomists from Lincoln University.

Farmers within the group were surveyed about the issues relevant to them and ranked topics for demonstration on site and at their own properties. Issues most commonly identified were:

- Pasture species combinations
- Nitrogen on pasture
- Fertilizers and brassicas
- Caucasian clover establishment
- Annual clover establishment and management
- Sowing rates of pastures
- Lucerne grazing management
- Oversowing on steeper hill country

A weather station was installed 1 km from the demonstration site to measure soil and air temperature, soil moisture, rainfall, wind and solar radiation. Air temperature and soil temperature are recorded at the demonstration site also. These data are used to relate pasture growth to the environment and compare Lees Valley weather conditions to other parts of Canterbury and the NIWA climate network.

Demonstration site background:

- Mt Pember Station has a total of 26,000 ha, of which 6000 ha is flat land.
- The demonstration site is on elevated (400 m a.s.l.) flat land.
- Prior to the experiment it was dominated by fescue and blue tussock grassland, browntop and matagouri scrub.
- Main growth constraints are 120 day winters and soil moisture deficits over summer coupled with shallow soils giving a short window of production.

Site preparation included:

- Double spray with Round up (4 l/ha) in April and October 2005 and lime applied (5 t/ha).
- The browntop mat was broken down by hoof and tooth from April to August 2005.

- In January 2006, 400 kg/ha superphosphate and 300 kg/ha DAP were applied to address fertility issues identified from soil tests taken in 2005.
- The site was then disced, harrowed and heavy rolled and fallowed until sowing.
- The first three demonstration blocks were perennial grasses, legumes/herbs and annual/forages. These were sown in February 2006 as randomised complete block design with four replicates (plot size 9 x 40 m).

Lees Valley entrance

Perennial grasses

- Five perennial grass cultivars were sown on 13th of February 2006. Due to unavailable seed at that time, two further species ('Revolution' ryegrass and 'Bareno' brome) were sown in November 2006.

Species	Cultivar	Sowing rate (kg/ha)
Ryegrass	'Aries HD' 5 kg/ha	5
	'Aries HD' 10 kg/ha	10
	'Aries HD' 15 kg/ha	15
	'Cannon LE'	8
	'Revolution'	8
Brome	'Bareno'	20
	'Gala'	20
Cocksfoot	'Kara'	3
Tall fescue	'Advance'	12
Timothy	'Viking'	5

- This experiment was split in half in spring 2007 for a nitrogen response trial. Half of the plots received 150 kg N/ha while remaining plots received none.
- In spring 2008 two of the four reps were used for a second nitrogen response trial using three rates of N (0, 75 and 150 kg N/ha).

Plots of perennial grasses

Pasture measurement:

- Pasture measurements taken by pasture probe (between rotations) or destructive harvests at the end of a rotation prior to grazing. Destructive harvests were then subjected to botanical composition and nutritive analysis through NIRS for sown species only. Post grazing residuals were measured with a pasture probe in cases where residuals were left.
- In spring 2007 and 2008 after nitrogen was applied, destructive harvests were taken frequently to capture changes in botanical composition and nutritive value (i.e., nitrogen and ME).
- Results are in the 2009 Field Day booklet pages 2-10.

Legume and herbs

Red and white clovers

- Six legumes (lucerne, white, subterranean ('Leura'), balansa, red and alsike clovers) and two herbs (chicory and plantain) were sown in February 2006.
- Due to a preferred spring sowing season, Caucasian clover was sown in a monoculture and with the herbs in November 2006.
- Subterranean ('Denmark') and strawberry clovers were sown after a fallow in February 2008.

Species	Cultivar	Sowing rate (kg/ha)
Perennial legumes	'Kaituna' lucerne	10.0
	'Pawera' red clover	5.0
	'Demand' white clover	4.0
	'Endura' Caucasian clover (Cc)	8.0
	Alsike clover	3.5
Annual clovers	'Leura' subterranean	10.0
	'Bolta' balansa	3.0
Grazing herbs and Cc	'Choice' chicory	0.6
	'Tonic' plantain	1.0
Perennial and annual clover	'Lucila' strawberry & 'Denmark' subterranean clovers	2.0 & 10.0

Pasture measurement:

- Pasture measurements were similar to perennial grasses.
- Results are in the 2009 Field Day booklet pages 18-20.
- Annual clover regeneration was quantified by measuring seedling emergence the year after sowing. Low emergence numbers indicated the possibility of a large proportion of hard seed. 'Leura' subterranean clover burrs were collected in May/June of 2007 and 2008 for germination testing. Germination results show 100% hard seed in both 2007 and 2008. After scarification with sand paper, there was 93% germination from both years.
- In September 2008, subterranean plant population counts were taken from a neighbouring trial (comparison of ± cultivation, two drill types and three rates of lime) sown in March 2007. Results show a subterranean population of 155 plants/m^2 when not cultivated and 2 t lime/ha was applied, compared to 543 plants/m^2 when cultivated and 6 t lime/ha was applied.

Subterranean clover plant populations (plants/m^2) 18 months after sowing.

		Lime (t/ha)		
Disc cultivation	Drill type	0	2	6
Cultivated	Cross slot	243	225	223
Cultivated	Triple disc	280	467	543
Not Cultivated	Cross slot	170	155	362
Not Cultivated	Triple disc	180	317	213

Caucasian Clover

Annuals/forages

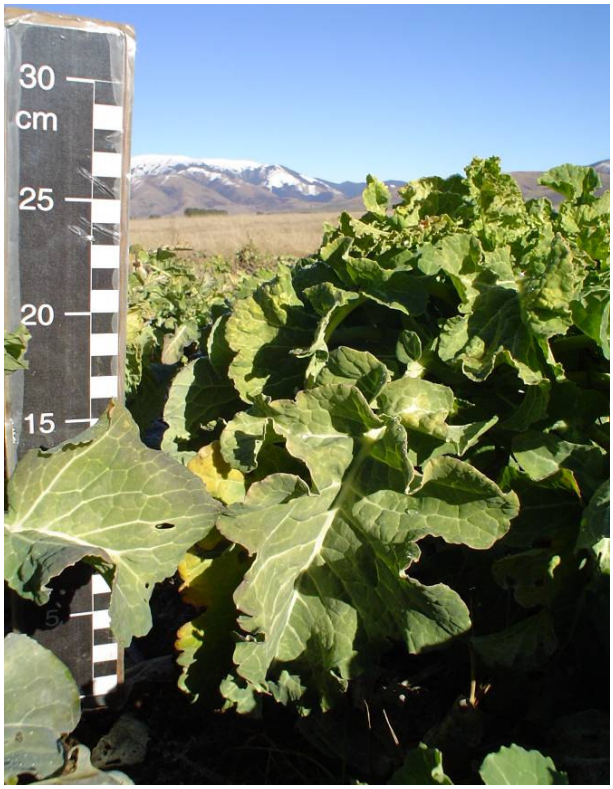
Ryecorn and Triticale

- Six grass/cereal cultivars were sown February 2006.

Species	Cultivar	Sowing rate (kg/ha)
Triticale	Double Take	100
Oats	Hokonui	100
Ryecorn	Rahu	100
Ryegrass (Italian)	Sonik	20
Ryegrass (Perennial)	Quartet AR1	23
Ryegrass (Hybrid)	Maverick Gold	20

- November 2006 two replicates of 'Barkant' turnips (1 kg/ha) and kale (3 kg/ha) were sown into fallow plots.
- December 2006 'Pasja' leaf turnip and 'Green Globe' bulb turnip were sown at 1.5 kg/ha.
- Cereals were sprayed with Roundup at 3 l/ha on 16th of January 2007 and later sown (30th of January) with 'Sonik' annual ryegrass at 20 kg/ha, or cereals (oats, ryecorn, or triticale) were sown at 100 kg/ha on the 21st of March 2007.

All treatments but 'Sonik' annual ryegrass were removed using Roundup (November 2007 at 2 l/ha and February 2008 at 3 l/ha). This experiment was then sown into three new experiments which consisted of perennial grass x annual clover (February 2008), dryland mixture (February 2008) or lucerne x lime trial (March 2008). These have been implemented to further study problems found in other areas of the trial.



Kale 2007

In 2008 new experiments were established following the annual forages:

- Perennial grass x annual legume experiment has two grasses ('Bronsyn' ryegrass or 'Dg25' cocksfoot) sown with a basal mix of white clover and either a subterranean ('Leura', 'Woogenellup' or 'Denmark'), red, arrowleaf or persian clover. This experiment is designed to identify suitable annual clovers for this environment.
- Lucerne x lime experiment, had two types of lime (Aglime or Quicklime) applied at four rates (0, 2, 4 or 8 t/ha) in March 2008 and lucerne was sown December 2008. The objective being to identify the lime application rates effect on soil pH and aluminium levels which may in turn influence on lucerne yield. Results are in the 2009 Field Day booklet pages 37-41.
- Dryland mixture (2008) consists of 'Dg25' cocksfoot, 'Bareno' brome, 'Fletcha' tall fescue (maxP) with basal clovers 'Denmark' subterranean and white clover.

Pasture mixtures

Grasses cross-drilled into legume base

- All sown on 30th of January 2007 with white (2 kg/ha) and 'Leura' subterranean (10 kg/ha) as basal clovers
- Ryegrass mixtures consist of six perennial ryegrasses.

Ryegrass	Sowing rate (kg/ha)	Other species	Sowing rate (kg/ha)
'Revolution' AR1	10	-	-
'Samson' AR1	10	-	-
'Cannon' HE	10	-	-
'Revolution' AR1	20	-	-
'Revolution' AR1	10	'Dg25' cocksfoot	2

- Dryland mixtures consist of five perennial grasses

Grass	Sowing rate (kg/ha)
'Advance' tall fescue	20
'Advance' tall fescue +endophyte	20
'Bareno' brome	20
Agriseeds 'Dg25' cocksfoot	2
'Ella' cocksfoot	2

- Timothy mixtures consist of timothy with chicory or plantain, chicory and plantain, red clover or by itself.

Grass	Sowing rate (kg/ha)	Other species	Sowing rate (kg/ha)
'Kahu' timothy	2	-	
'Kahu' timothy	2	'Choice' chicory	1
'Kahu' timothy	2	'Tonic' plantain	1
'Kahu' timothy	2	'Choice' chicory & 'Tonic' plantain	1 & 1
'Kahu' timothy	2	'Pawera' red clover	4

- Results are in the 2009 Field Day booklet pages 32 - 36.

Honours students (2007)

- Understanding how sowing rate and date effect autumn lucerne establishment in Canterbury (Brad Lewis). Results are in the 2007 Field Day booklet pages 22 and 23 or 2008 Field Day booklet page 14.
- A comparison of establishment methods of permanent pasture into an undeveloped depleted tussock grassland (Edward Tapp). Results are in the 2007 Field Day booklet pages 2-4 and 2008 Field Day booklet pages 2 and 3.
- Yield of turnips and kale grown under drought conditions in Canterbury high country (Robert Reynolds). Results are in the 2009 Field Day booklet pages 23-25.

Soil fertility

Soil tests were taken annually in August. Nutrient deficiencies were addressed as required. Application of fertiliser followed a similar routine to Mt Pember Station. Results are in the 2009 Field Day booklet.

Other measurements around the Valley

In winter of 2006 and 2008, an existing commercial brassica paddock had an application of N at various rates. In 2006 five rates were used (0, 25, 50, 100 and 200 kg N/ha) using split applications of ammonium sulphate, calcium ammonium nitrate (C.A.N), Sustain and urea during the late summer and autumn of 2006.

Autumn N in 2008 was applied to kale at three rates (0, 50 and 100 kg N/ha). Results are in the 2009 Field Day booklet page 26.

Twenty one cage cuts around the valley were started by staff at Mt Pember Station formerly, Landco Ltd. Turn over in staff meant cage cuts were taken on by Lincoln University on 22/11/2007 through to 26/3/2009 with cages being left over winter (April-November). Cages were harvested every 21-28 days. Results are in 2009 Field Day booklet page 42.

Lincoln University Students and visiting scholars from abroad

Third year Plant Science students from Lincoln University studied various trials at Lees Valley, in particular early spring growth of perennial grass monocultures, ryegrass and dryland mixtures and lucerne yield and root:shoot ratio two years after establishment. They also studied the brassica x nitrogen trials around Lees Valley in winter 2006.

Visiting students from Brazil, France, and Turkey have assisted with measurements of the experiments and were able to learn about South Island hill country farming systems.

Field Days

Open and farmer group only Field Days were held at the site on 28/3/2007, 8/11/2007, 20/11/2008 and 8/4/2008. The Field Days were an opportunity for farmers to see progress at the site and yield records. This also was an opportunity to seek advice from leading pasture and brassica scientists from Lincoln University and for them to make suggestions for any changes in the trial going forward.

A comprehensive summary of all data is available upon request and has been presented in the Field Day booklets.