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Optimization of subterranean clover for dryland pastures in New Zealand.

Sustainable Farming Fund 2015-2016

Progress Report for Milestone M3755

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Introduction

This report outlines the selection of sites and establishment of an experimental programme related to the use of subterranean clover in New Zealand. The scientists have visited potential sites in the North and South islands and selected six for more intensive investigation of the use of sub clover for New Zealand conditions. The overall package has been refined to examine a range of agronomic questions and produce a comprehensive understanding of sub clover growth and development. The integrated approach has a mix of on-farm demonstration, on farm experiments, on station experiments and a range of linked questions to answer.

From these the overall project aims are;

1) to define the potential of subterranean clover to provide early lactation feed in New Zealand dryland environments and,

2) to identify solutions to agronomic and edaphic constraints to achieving that potential across different sites in New Zealand.

To do this a series of objectives have been refined as appropriate for the sites selected, local farmer questions and environmental constraints at each location. The different components of the research will inform a comprehensive agronomic package for sub clover use in New Zealand, demonstrate those benefits on farm and outline potential requirements for further research.

The first milestone (M-3754) for this project was completed with submission of a comprehensive literature review on subterranean clover (30/11/2015).

This report details evidence that Milestone 3755 has been completed:

- dryland pastoral areas identified as being suitable for a range of experimental and demonstration subterranean clover cultivar trials,
- activities of the project members to identify in each area,
- methods and timelines for the preparation of the sites, and
- current status of the trials.

Farms in the following areas of New Zealand were visited to identify suitable experimental sites for this subterranean clover research project: McKenzie Basin, Central Otago, South Canterbury, Mid-Canterbury, North Canterbury, Marlborough, Wairarapa and Hawkes Bay. From these areas, six have been selected for a total of 11 experiments to investigate a range of experimental treatments that will optimise the establishment of subterranean clover cultivars. There is also a demonstration site installed at Wairoa that can be used in an advisory capacity for a farmer discussion groups.

Map showing location of experimental and demonstration sites:

Experiment locations and site preparation

McKenzie Basin

At Omarara the key question being investigated is the cold tolerance of subterranean clover cultivars in a high-country environment. Three sites were visited by Professor Derrick Moot or Mr Dick Lucas at Glenmore station, Bog Roy and Omarama station during winter/spring 2015. A final selection was made in August 2015 with the assistance of Bill Gordon, Farm manager at Omarama Station. A hill and flat site were considered and the flat site finally selected to allow drilling to occur at this coldest site. The aim was to ensure as successful establishment as possible in this area of 300 mm rainfall. The risk of failure from oversowing was considered too great to use a hill block.

Objective 1: To assess the cold tolerance of sub clover cultivars. To do this sub clover survival, dry matter production, reseeding and regrowth will be assessed over two years. The work will be conducted in association with a merino bench marking group and results distributed to them through their facilitator.

Experimental site: Omarama Station, farmer is Richard Subtil

Address: 59 Omarama-Lindis Pass Rd, Omarama 9448

This experimental site, located at -44.506566, 169.901419, was chosen because of its altitude (477 m) and relatively flat topography which meant that the site could be sown using the Lincoln University research drill.

Site preparation

Pre-drilling site preparation included the addition of the following fertilisers and herbicides:

Date	What and rate
Aug 15	Fertiliser: Lime at 3 t/ha
11/9/16	Herbicide: 3.5 L/ha 2,4-D Ester
18/9/16	Herbicide: 8 L/ha Glyphosate (470 a.i.) with Sharpen
18/9/16	Micronutrients: 3.5 L/ha MoBstar with 100 g/L a.i. boron and 35 g/L a.i. molydenum
10/2/16	Herbicide: 5 L/ha Glyphosate (470 a.i.) with a small amount of oxyflurofen.

By mid-February 2016 the site was described as ‘relatively trash free’.

Current status

Two experiments were direct drilled on 18th February 2016.

Associated farmer group/stakeholders at Omarama

- Liam Donnelly (Seed Force)
- The objectives for these experiments were discussed by Richard Lucas (Lincoln University) and Liam Donnelly (Seed Force) at the South Island Farmer of the Year Field Day at Omarama Station, on 26th February 2016, which was attended by an estimated 280 people.
- The Merino benchmarking group were informed of the establishment of the research programme by Prof. Moot at their meeting on 22nd March 2015.

South Canterbury

Site selection focused on the Cave area, inland from Temuka, and was carried out in November 2015 by Professor Derrick Moot (Lincoln University) and James White from SeedForce Limited. Two sites were investigated and one at Rock Farm was selected because of the opportunity to utilise farm-scale drillable areas on a sloping topography. The clay subsoil provides an impediment to drainage which is a common situation in soils in the area. Therefore the site will enable the survival of sub clover culitvars to be assessed in water logged and free draining conditions. Unfortunately, post-planning it was determined that the site was too steep to be sown with a research plot drill so the experiment was modified to allow large machinery to be utilized.

Objective 2: To assess the survival and production of sub clover cultivars on clay soils prone to water logging. To do this the establishment, growth and production of six sub clover cultivars will be assessed in large plots that cover a range of topography.

Experimental site: Rock Farm, Cave, farmer is Herstall Ulrich

Address: 1353 Pleasant Point-Cave Hwy (SH8), South Canterbury

This site (trial centre located at -44.312587, 170.963268) is on an undulating slope that faces west.

Site preparation

Date	What and rate
9/9/15	Fertiliser*: 200 kg/ha Ammo31 and 2000 kg/ha dolomite
9/11/15	Fertiliser: 190 kg/ha Nprotect
5/1/16	Herbicide: 3 L/ha Glyphosate 360
2/2/16	Herbicide: 2 L/ha Glyphosate 360 plus 40g granstar
12/2/16	Fertiliser: 250 kg/ha Crop20
25/2/16	Cultivation: site lightly cultivated with a tractor-drawn Ground Hog soil aerator

* Fertiliser applications made after soil tests were carried out in April 2015.

Current status

Site preparation was completed 25th February 2016.

The experiment was sown on 3rd March 2016.

Associated farmers group/stakeholders in South Canterbury

The local South Canterbury farm discussion group that Herstall Ulrich chairs will be the first point of contact to discuss experimental results and remain informed throughout the programme. The site has tentatively been booked to be shown to the New Zealand Grassland Association Conference (350 delegates) at their on-farm visit in November 2016.

Drilling the Cave experiment, 3/3/16 (Photo: Sonya Olykan)

Mid-Canterbury

Two experimental sites on Lincoln University owned farms were selected by Professor Derrick Moot and Mr Dick Lucas (Lincoln University). These sites are representative of dryland farming sites on the Canterbury Plains, foothills and Banks Peninsula. The work here will be more detailed and provide the scientific integrity required to underpin the more extensive on-farm work at remote locations.

Experimental site 1: Iversen Fields, Lincoln University campus

Two fields at this site (location -43.649, 172.468) host subterranean clover cultivar trials:

Experiment 1: Subterranean Clover phenology experiment (Iversen 2)

Objective 3: To quantify the phenological development of six sub clover cultivars. To do this six cultivars will assessed across seven sowing dates.

Detailed measurements of vegetative growth and reproductive development will be used to assess how temperature and photoperiod affect plant development. This will allow a matching of cultivar to environment based on the duration of spring moisture supply and temperature regimes prior to summer drought. A validation study has been established at the sixth site in Hawkes Bay.

Site preparation

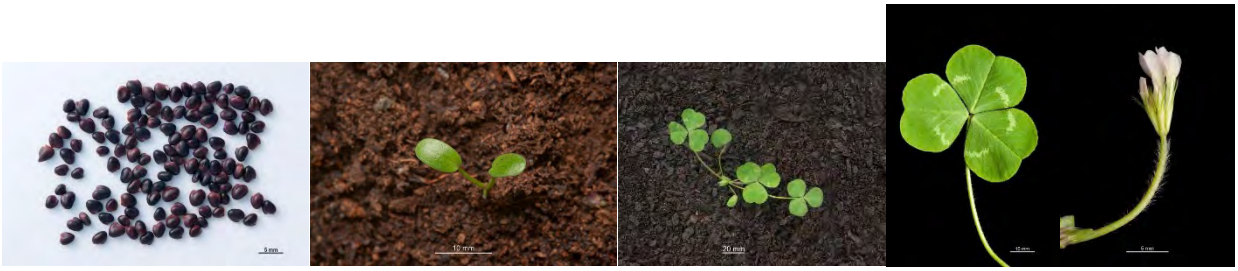
Date	What and rate
14/6/15	Fertiliser: 2500 kg/ha Lime, 500 kg/ha Superphosphate
17/6/15	Herbicide*: Roundup 630 mL/ha in 100 L water
21/7/15	Herbicide: Roundup 630 mL/ha in 100 L water
8/9/15	Herbicide: Roundup 630 mL/ha in 100 L water
27/10/15	Herbicide: Roundup 630 mL/ha in 100 L water
8/12/15	Herbicide: Roundup 630 mL/ha in 100 L water
10/2/16	Herbicide: Roundup 630 mL/ha in 100 L water
8/3/16	Herbicide: Roundup 630 mL/ha in 100 L water

* The area of each sowing date was sprayed 5-7 days prior sowing.

The subterranean clover cultivars in this experiment were sown in adjacent plots on the following dates: 24 June 2015, 28 July 2015, 15 September 2015, 5 November 2015, 15 December 2015, 17 February 2016 and 15 March 2016.

Current status

Site preparation was completed in March 2016. This experiment is currently being monitored and measured as part of a postgraduate research project.



Sub clover cultivar 'Antas' – seed, cotyledon stage, 5 trifoliate leaves, leaf and flower.

Experiment 2: Subterranean clover herbicide tolerance (Iversen 1).

When establishing subterranean clover there is little relevant information on the ability to use chemicals for weed control. This experiment will assess the impact of several common herbicides used to control broadleaf weeds in pastures.

Objective 4: To assess the herbicide tolerance of a range of subterranean clover cultivars.

Experiment site 2: Ashley Dene, Canterbury

The experiment at this location (Paddock C9, -43.649597, 172.323270) will investigate the herbicide tolerance of subterranean clover cultivars at two stages of seedling development.

Site preparation

There have been no recent fertiliser applications.

Date	What and rate
22/2/16	Herbicide: Buster 5 L/ha in 200 L water
21/3/16	Herbicide: Buster 5 L/ha in 200 L water

The experiment was direct drilled on 22nd March 2016 and then rolled on 23rd March 2016.

Current status

Site preparation completed and the experiment has been established.

Associated farmer group/stakeholders in mid-Canterbury

The experiments at both sites will be utilised in post-graduate student research projects and undergraduate student teaching. This involves 250 students being introduced to the research programme annually.

North Canterbury

Site selection in the North Canterbury involved visiting four potential farm sites in November 2015 by Professor Derrick Moot and Mr Dick Lucas (Lincoln University) with Andrew Johnston from Luisetti Seeds. Koromiko Farm was chosen because of its hilly terrain, low soil pH and being representative of thousands of hectares of hill country in Nth Canterbury.

Experimental site: Koromiko Farm, Lowry Hills Range, farmer is Hugh Crossley

Farm address: 180 Fagans Road, Rd 2, Cheviot 7382

This farm (site located at -42.783940, 173.058481) will host two subterranean clover experiments. Because of the low soil pH of 5.2 a rates of lime application will be included.

Objective 5: Identify options for establishment of sub clover through oversowing.

Experiment 1: Subterranean clover oversowing

This experiment, is located on uncultivatable hill country. Herbicide application has occurred on three occasions throughout the dry summer period and oversowing with a mixture of subterranean clover cultivars will occur in early April. Both activities will be carried out using a helicopter.

Three different herbicide combinations (2 rates of Roundup or Redglone) plus a control, have been applied across a hill site that has 4 ha of sunny face and 8 ha shady face. Each site has received three applications of its respective herbicide:

Date	What and rate
Nov 2015	6 L/ha Roundup, 3 L/ha Roundup, or Reglone applied by helicopter
Jan 2016	6 L/ha Roundup, 3 L/ha Roundup, or Reglone applied by helicopter
Feb 2016	6 L/ha Roundup, 3 L/ha Roundup, or Reglone applied by helicopter

Experiment 2. Rate of lime application on sub clover establishment

Once the hill country area has been oversown a small area (e.g. 20 x 20 m) will be dressed with lime sulfur and reseeded to examine whether the additional lime assists establishment and persistence of sub clover seeds.

Area of hill country in Cheviot sprayed with herbicide (Photo: Gracie Woolsey)

Site preparation

Experiment 1 received three herbicide sprays, as noted above, and farm records show the only significant rainfall event occurred in early January. A further site inspection occurred on 11th January to decide on the second spray and then a final inspection on the 18th March occurred in preparation for oversowing.

Current status

Site preparation has been completed for Experiment 1 and it will be oversown in early April.

Experiment 2 will be established immediately after the oversowing has occurred.

Associated farmer group/stakeholders in North Canterbury

- This experimental site is part of a post-graduate student research project.
- Andrew Johnston (Luisetti Seeds) is overseeing additional farm activities associated with the site.
- Wayne Allan (Allan Agricultural Consulting Ltd) facilitates the Cheviot discussion group that the farmer is a part of and they will be the focus group for this work and will visit in May.

Wairarapa

Site selection was undertaken in September and November 2015 by Professor Derrick Moot (Lincoln University) and Malcolm Macfarlane (On-Farm Research). They visited five farm sites and identified two that were suitable at Tokoroa Farm, Ponatahi, and Glenside Farm, Taratahi. Annette Litherland (Taratahi Agricultural Training Centre) was present at the Glenside Farm site.

Objective 6: Increase sub clover component in mixed swards through grazing management.

Experiment site 1: Tokaroa Farm, Ponatahi, farmer is Dan Nicholson

Address: 1106 Ponatahi Road, Carterton 5792

Experiment 1: Management to increase resident subterranean clover - exclosure demo areas

At this location (-41.157046, 175.543485) three exclosures were built to exclude grazing stock for different lengths of time to investigate the impact of spelling on resident sub clover growth.

Site preparation

Exclosures built 26-27th September 2016:

Tokaroa Farm – exclosure experiment (Photo: Malcolm Macfarlane)

Visits to open exclosures and collect plant material on 20th October 2015, 7th November 2015 and 30th November 2015. Plant material samples sent to Lincoln University for processing.

Current status

Site preparation and Year 1 of sample collection completed. Data to be processed.
Experiment will be repeated in spring 2016. Measurement will seek to determine the total sub clover composition of pastures after three different spring grazing managements.

Experiment 2: Subterranean clover cultivar trial

This trial will evaluate subterranean clover cultivars that may be suitable for introduction to pastures through direct drilling in this environment. This will assist the completion of Objectives 1, 2 and potentially 3.

Site preparation

Herbicides applied on two dates:

Date	What and rate
Nov 2015	3 L Roundup Transorb + 40 g Granstar in 125 L/ha
Feb 2016	3 L Roundup Transorb + 100 ml Pulse + 40 g Granstar in 125 L/ha

Current status

Site preparation has been completed.

Sufficient rainfall needed before drilling will be undertaken. Currently scheduled for early April 2016.

Experiment site 2: Glenside Farm at Taratahi

Address: Martinbrough - Masterton Road, Carterton

The experiment at this location (-41.120529, 175.645535) will look at the effect of 4 different herbicide treatments, applied by helicopter, on the establishment and growth of subterranean clover cultivars. The results will inform Objective 5 – related to options for oversowing.

Site preparation

26th November 2015 – site was marked out
1st December 2015 - Spray one strip with herbicide Roundup 4 litres & 100 l water/ha
Post autumn rains – remaining herbicide treatments will be applied just before seed sowing.

Glenside Farm – impact of the Roundup treatment (Photo: Malcolm Macfarlane)

Current status

One herbicide application has been completed. The other treatments will be applied just before sowing. Waiting for sufficient rainfall to allow seed sowing. Currently scheduled for late March/early April 2016.

Associated farmer group/stakeholders in the Wairarapa

A Wairarapa 'sub4spring' discussion group (25 members) has been formed after an initial farmer meeting on 3rd September 2015. The target is demonstration of principals in Year one and then application on other farms for year 2 and beyond.

Taratahi Agricultural Training Centre will also use the oversowing site for teaching as it develops.

Hawkes Bay

Site selection was carried out in November 2015 when Derrick Moot (Lincoln University) and Malcolm Macfarlane (On-Farm Research) investigated 3 farm sites and identified two that were suitable:

Experiment site 1: Poukawa Research Station

This site (location at -39.746568, 176.734247) is a suitable location for the subterranean clover cultivar experiment. This will provide validation data for completion of Objective 3 (sub clover phenology).

Site preparation at Poukawa (Photo: Carmen Teixeira)

Site preparation

No fertilisers have been applied to this site recently

12th February 2016 – Herbicide application was Roundup 630mL/ha in 100L water.

The site was rotary hoed before seed sowing.

Current status

Site preparation completed in February 2016.

Subterranean clover seed was sown on the 19th February 2016. Another sowing will occur mid-April 2016.

Two further sowing dates are scheduled for each season in 2016 and 2017.

Demonstration site 2: Waiau Station, Wairoa, farmer is Dave Read

Address: 61 Rangiahua Rd, RD3, Wairoa 4193

This site will be used in an advisory capacity for a farmer initiated Wairoa discussion group.

Site preparation

20th March 2016 – the block is being grazed.

Cows grazing in 7th break, Waiau Station, 20th March 2016

Current status

This demonstration will assist the completion of Objective 5. Site preparation has been completed. A blend of the subterranean clover cultivars Monti, Denmark, Woogenellup, Leura and Antas will be sown in early April 2016 as soon as some rain has fallen. Post sowing, the seed will be trampled in by sheep.

Associated farmer group/stakeholders in the Hawkes Bay

- Andrew Johnston (Luisetti Seeds) - development of a Wairoa farmer discussion group with expert input from LU as requested
- An on-farm demonstration of sub clover introduction to hill country will be supported for the Wairoa sub clover discussion group at Waiau Station, near Gisborne.