

Wairoa Field Day

Wednesday 9th November, 2016



Weaned cows in 6th break C Trig, 20 Mar 16. Photo: Dave Read.

Lincoln University 'Sub 4 Spring'

Professor Derrick Moot and Mr Dick Lucas

- ♣ Role of sub clover in dryland systems
- ♣ Suitability of different sub clover cultivars

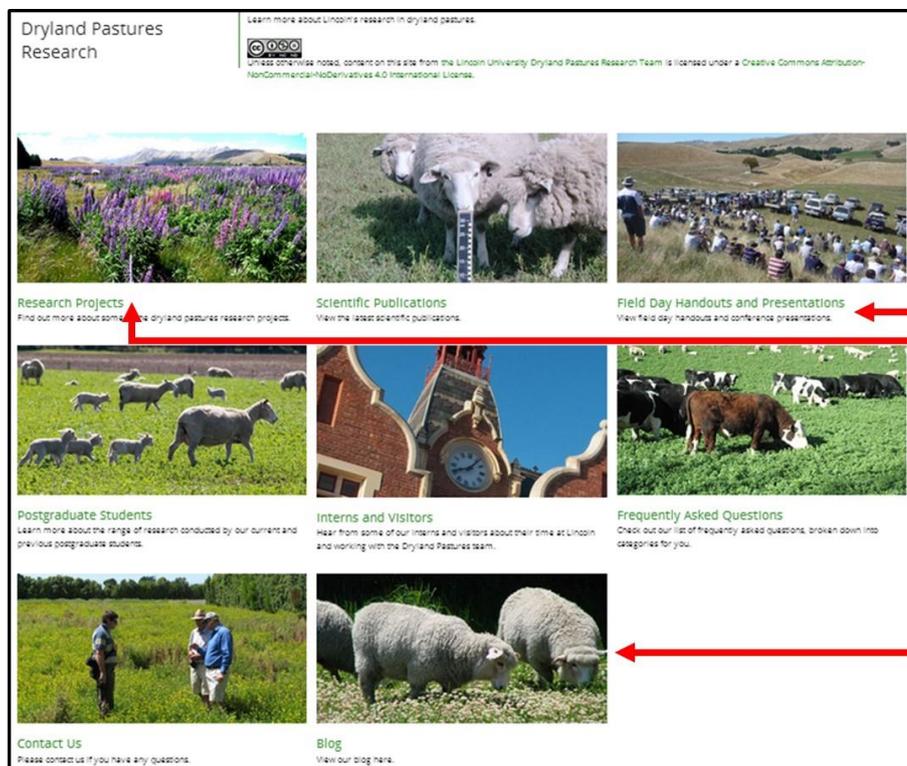
"This work was undertaken as part of Phase II of the Pastoral 21 Programme, funded by the Ministry for Business, Innovation & Employment; DairyNZ; Beef + Lamb NZ; and Fonterra, and Ministry for Primary Industries, Sustainable Farming Fund."



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Websites & Social Media

- Website: www.lincoln.ac.nz/dryland



DPR website

Info on:

- Field Day presentations
- Current research projects (inc access to Maxclover Photo Diary)
- FAQs
- Postgraduate study
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- Blog: <https://blogs.lincoln.ac.nz/dryland/>
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Sub clover diary

Dave Read, Waiau Station, Wairoa

Before I start I would like to thank Gavin Sheath, Derrick Moot & Dick Lucas: they have all been extremely generous with their time.

2008/2009

A prolonged dry spell from August till April convinced us that 12 su/ha was unsustainable on our class VI & VII hill country, with at least one third north-facing. Reduced to about 10 su/ha. About this time Trevor Cook started facilitating our discussion group.

2011

By about now Trevor's message to feed ewes 4 weeks pre lamb & through lactation started to gain traction for us. It resulted in us attempting to maintain covers at or above 1200 kg DM/ha right through spring.

About this time I began to notice a patch of sub-clover [I didn't know what it was at that time] in my heifer calving block which had had only cattle spring-grazing for about 12 years. It was right beside the track in an old erosion scar; I used to admire it on dewy mornings when travelling out to check my heifers. After doing some research and talking to Dick Lucas, I discovered that Gavin Sheath had done work on sub clover in the North Island and that he visited Wairoa occasionally.

Nov 2011

Jude & I spent a very informative afternoon with Gavin, looking at a couple of sites out on the farm. By now I knew to look for the little white trumpet flowers that are so different from the pompom white clover flowers. I was starting to see the odd plant on a lot of my sunny faces. A result of our lighter spring stocking and my heightened awareness of it. The previous owner told me his family had spread some seed in the 1970's with their super. Gavin identified it as Mt Barker. He advised us to graze it lightly over the flowering period with cattle, rather than shut it up completely as they do down south to get a good seeding, as in our environment grass would be too much competition, forcing the sub up to the light and meaning its burrs would be unable to bury in the ground and so would produce predominantly "soft" seed that would all germinate at the first rain. Gavin thought that what we had was possibly better than anything we could buy. When originally sown it had quite a wide genetic base which over the last 40 years had adapted to our conditions & management. Its survival under hard sheep grazing was a testament to its hardiness. However he warned us that promoting it would be a long process, as it only expanded 20-30 cm a year. At this time I was getting enthusiastic about its potential, I had read about the Grigg's success with

it in Marlborough and the impressive stock production gains they had achieved. I had a vision of it cascading over the sheep tracks on my steepest hills!

2012-2015

We identified the 10 paddocks with the highest proportion of steep north facing country. These were set stocked with yearling cattle plus a few dry fattening R2 heifers over the mid-August till Christmas period. In a dry year the numbers were reduced, as these cattle were predominantly part of our system of “buffer mobs”, ready for sale in a dry spring.

We made slow improvement in the amount of sub present, but nothing dramatic [less than 5% coverage in most cases]. Despite this the cattle on this country manage to put on in excess of 750 g/day over the four month period. When we got enough rain in the autumn to germinate these blocks were destocked until the sub got to the four true leaf stage. This was not the problem that I thought it would be; the shady/lower slope country came away a lot quicker than the steep dry country and we really didn't miss 10% of our area being out of production for a few weeks. Also because we have moderately good soil fertility and have de-stocked a lot if the dry was serious, the good country tends to explode as soon as we get a soaking. This will be an area for more management changes if we manage to establish sub on all the sunny third of the farm. We do feed willow and we could increase this on the shadier country once rains come.

Mid-Mar 2015 - 100mm of rain after a prolonged dry spell: huge germination of sub clover.

Mid-April 2015 - Hot windy weather, any rain followed by wind. Sub-clover only surviving on sunny slopes with an easterly aspect. Although our sub is adapted to our conditions will it survive if we get dryer?

May 2015 - Went to Aginovation in Fielding. Dick Lucas persuaded me to try some new varieties of sub. Trialled the four varieties I could source at short notice. Sowed by hand on some steep country, no proper preparation, I thought it was too late in the season. Sowing followed by very nice rain. Good germination on the steepest country especially on bare sheep tracks, a poor result on easier hill with more pumice, probably too much grass cover?

Sept 2015 - Gavin & Andrew Johnston, visited. Andrew arranged a field day with Derrick Moot.

Nov 2015 - During the field day we identified a suitable paddock [Trig: 12.6 ha] for sowing autumn 2016. A high percentage of North facing dry country with minimal resident sub present plus quite a bit of easier dry pumice country that should be able to produce more [but looks shocking at present].

Dec 2015 - Ordered seed: Monti, Denmark, Woogenellup, Leura + a dash of Antis. I wanted to sow a wide range of varieties, mixed, so that some of what I sowed might be suitable in each microclimate on our hills. I had been advised against anything that was too hardseeded [over 3]. I included a dash of Antis, but I think our country is probably too harsh for it. Dick Lucas thought it may have a place on our pumice country where its poor burr burying ability may not be such a disadvantage, due to the softer soil. With its distinctive big leaf we will be able to easily track its survival. The key will be varieties that can re-seed themselves year after year as I only want to sow once.

13 Mar 2016 - Started break grazing Trig with 200 R2 & R3 recently weaned cows. A lot of rank old grass but a good bottom in any places with a bit more moisture. Cows were given approx. 0.75 ha/day, tried to get some good feed in each day's break along with the rough dry feed on worst dry faces. Mob took 17 days to clean up whole paddock. Was only able to back fence three times as we were limited for water as the cows made the first dam so muddy they were too scared of getting stuck to get in. Hot, dry weather apart from 2 good day's rain at Easter. Tricky to get the breaks with an even amount of feed: steep broken country, need to get a vantage across the valley to plan out breaks, made harder by the huge variation of quantity & quality of feed [a range of 1200 kg/ha dry dead grass - 3500 kg/ha of reasonable quality]. We have been so impressed with the job that these cows are doing that we have continued to break graze them until ewes are able to be worked [end of May] and joined with cows to make a working mob.



Cows in 7th break, 20 Mar 16. Photo: Dave Read

Break grazing took approx. 1 hour/day, used belt to hold reel while running poly wire & laying pegs. No need for a gym subscription!

Next year: Weigh cows at start of break grazing to see how much condition [if any] we are stripping off them. A Pack frame set up for carrying pegs would be useful.

23 Mar 2016 - Sowed first half of trig with a “fiddle” [last used early 1960’s to sow bush burns!] Test runs established that a setting of 2.5 seemed to give about 10 kg of sub/ha with a 6 m spread [3 m either side]. However some of trig is so steep that spread uphill was probably not much. Used an electric peg with a rag tied on it on each spur to get a rough gauge for my 6m. With the fiddle was able to shut off on any shady slopes where there would be too much competition from grass & where white clover was. Jude had to make a new cloth top to the fiddle as the old one was not going to last another day! *Sowing took 3 hours for 40 kg, sowing approx. 60-70 % of the total area.*

24 Mar 2016 - Brought in a mob of 500 ewe hoggets to tramp the seed in. Our ewes are all being flushed, so not able to use them. A hot afternoon, after one lap they were all panting. The pumice soil was so dry they were not compacting it at all, in fact probably fluffing it up even more.

Next year: Will sow each break the day before the cows graze it, they can graze & tramp in one pass.

25&26 Mar 2016 - A beautiful steady two days of rain [60 mm].

29 Mar 2016 - Sowed last half of Trig. Walking the whole paddock revealed more resident sub than we had thought present in the spring. We had quite a big strike in late January when we had 50 mm followed by some cooler weather + a bit of follow up rain in early February, these plants died on the driest faces, and we had been unable to see much elsewhere during late Feb/early Mar. However quite a few plants must have survived [by staying very small?] because the plants I was seeing now were more developed than the newly germinating plants on the first half of the paddock, which only had their 2 cotyledon leaves.

9 April 2016 - 15 days since rain, clover plants at the first true leaf stage.

27 April 2016 - Plants looking good.

27 April 2016 - Plants 5 weeks old, 4-6 true leaves.

4 May 2016 - Plants 6 weeks old. Two very hot dry weeks, plants have made no new growth, but still alive. Soil is very fluffy anywhere there is no old grass to hold it together.

13 May 2016 - Grazed paddock lightly with 200 weaner heifers for two days. The shady slopes were getting long grass, starting to fold over. Weaners did a small amount of damage on worst pumice slopes by disturbing soil.

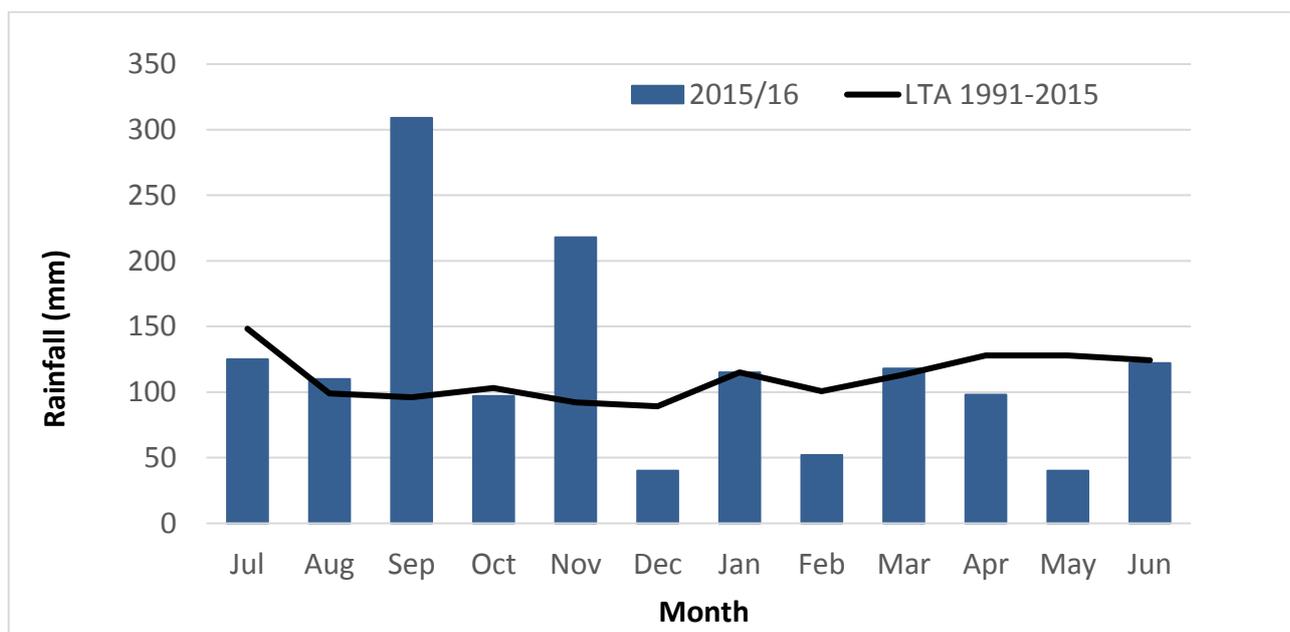
7 June 2016 - set stocked small number of light weaners & light ewe hoggets.

14 June 2016 - removed all hoggets, plenty of feed on damper slopes but hoggets grazing sunny slopes.

Next year: After four true leaf stage set stock with low CS cows to control grass. They shouldn't run around so much and they will not be looking to strip mine clover [hopefully].

Very depressing, way less sub than on previous visits. The sunny slopes are still very dry, even the Californian thistles are yellowing off. Since germination we have only had one fall of rain greater than 20 mm. There has been a lot of hot weather and wind. In May we have had 40 mm [35% of normal] we are still getting some days into the lower 20 degrees. I hope that, just as after the January rain, there is more sub surviving than it looks, otherwise we try again next year.

30 June 2016 - Grazed for two days with 600 ewe hoggets & 20 dry R1 heifers.



Rainfall at Waiau Station from July 2015 to June 2016 (data from by Dave Read).

14 July 2016 – 57 mm rain 23 June with follow up rain every 3-4 days + warm temps. Soil moisture has recovered even on driest faces. I may have been overly pessimistic: there appears to be more sub than before [still a lot of bare ground with browntop? a very fine grass] germinating. On the farm as a whole sub seems to have fared a lot better on steeper siltstone country. Is this just a result of this year's very dry autumn/early winter, or is it what we should expect every season?

22 July 2016 - Have realized that in determining which paddocks should be grazed primarily to benefit sub clover, that if that treatment is detrimental to moist areas in the paddock [for example this year sub areas were not ready to be grazed, but moist areas were getting too long], then we need to decide not on the basis of area alone, but on value of feed produced over a year on each area. It would be very beneficial to assess what species are present in each aspect, then sit down with a pasture specialist and work out what management is needed at each season to shift the composition to

a more economically favourable one, and identify when we are likely to face a conflict between management of dry/moist areas.

28 Aug 2016 - Two weeks the longest spell without rain & mostly a small top up every few days & apart from brief cold spells it has been warmer than normal; the spring flush of growth has kicked in. 31 R1 Heifers set stocked 22 Aug on sown block. Bare ground is filling in with Browntop? & Lotus Hispidus? There will be enough sub plants to get a reasonable cover after one self-seeding [I hope]. Still disappointing compared to what there was. Plants are behind in size compared to resident sub in other paddocks where it is looking good in pumice areas as well as mudstone. The resident plant I washed & photographed had way less other roots entangled with its root system. So is it bigger because: less matt of roots to contend with; germinated earlier and managed to survive the dry; or got off to a better start because the seed was buried in a burr? Could we improve the start of sown seeds by getting better compaction? Is the fact that the resident plant I photographed came from a small, but almost pure patch of Sub clover a worry in the autumn it must have been essentially bare ground & that is a risk on our steeper slopes?

It is noticeable that the areas break grazed before the Easter rain have way more winged thistles than the areas grazed later. Do we actually need to bare out the ground to get good germination of resident seed [once there is a good seed bank]? This season it would appear not. Will the germinating seed be able to survive shading until it is strong enough to be grazed?



Best sown sub plant from Craig's trig - note dense web of other roots (28 Aug 16, Photo: Dave Read)



Average sown sub plant from Craig's trig (28 Aug 16, Photo: Dave Read)



**Resident sub clover in Horse Paddock - taken
from a small almost pure patch
(28 Aug 16, Photo: Dave Read)**

6 Sept 16 - 33 Heifers dosed & weighed [220-230kg]: eid individual weights

17 Sept 16 - added 4 cows. Some sub flowering: Monti [by Derrick's ID chart]

12 Oct 16 - removed 4 cows. Dry faces are getting grazed out a bit low, but fertility patches are still longer than I would like. Perhaps a mix of older cattle all through spring would improve this?

Once we get a good bank of hard seed perhaps we can set stock some early lambing ewes with R1 heifers + some cows. Remove ewes [sometime in October?] to shady country to control the later spring flush of growth as this country warms up.

Will having the early flowering Monty in the mix make this sort of management too difficult?

Since the start of August, 12 days is the longest that we have gone without rain. Great for the dry sunny faces, they are really starting to fill in. Resident Mt Barker is flowering strongly, Prevalence of Rats tail has diminished a lot, especially where we have been calving heifers for 11 years now [1st season round there Spring 2005] . Much more sub than I had thought in mid-winter.

I am looking forward to Derrick identifying what other varieties of sub have established. Of course the real test will be what manages to re-establish its self this autumn.

2 Nov 16 - removed 34 R1 heifers have averaged 1.0 kg/d over 57 days: 6/9/16-2/11/16

34 heifers av 250 kg at mid-point at +1.0 kg/d= 6.7 kg DM/d = 9166 kg consumed

4 cows at 450 kg for 26 d [due 15 Oct] at +1 kg/d=15 kg DM/d = 1560 kg

Total = 10.7 T

Feed consumed = av 15 kg DM/d over 57 days

In late Aug we were predicting only 12 kg/d due to extremely dry winter & poor species on dry faces.

What has it grown? Covers are higher now than when R1 heifers went in. Would guess that 6.6 ha of sunny slopes have gone from 1000 kg/ha to 1200 kg/ha. 6 ha of easier country from 1200 to 2000 kg so net gain of about 6 T would give a total grow of 16-17 T over 57 days= 22-24 kg DM/ha/d.

We have struggled to control fertility patches, while the sunny faces have been grazed out possibly a little too hard. I am removing the stock completely now as I feel that the heifers are hitting the sunny faces too hard. Perhaps older cattle would do a better job?

Dryland Pastures Research Team

Mission statement

“To provide research results that assist dryland pastoral farmers to develop resilient farm systems that are financially, economically, environmentally and socially sustainable.”

The Problems

- Dryland sheep and beef properties usually start the spring season with full soil moisture recharge but run out in summer.
- The amount of water available is dependent on the soil water holding capacity of the soil, the ability of the pasture species to use the water efficiently, and in season rainfall.
- Nitrogen is always deficient in grass dominant dryland pastures and this reduces water use efficiency of the plants.
- The herbage produced must be high quality to maximize live-weight gain during lactation in the reliable spring growth period.
- Lambs born at ~5 kg must grow at least 300 gm/hd/d to achieve 35 kg liveweight in 100 days (before soil moisture runs out).
- Lambs still on the farm during the dry summer months compete with ewes for priority forage. This may affect the ewes condition going into mating and subsequently lambing performance the following year.

The Solutions:

- High quality forages that maximize water use efficiency (kg DM/mm/ha) and water extraction (Lucerne).
- Pasture species that fix nitrogen and grow early in spring when soil moisture is available (Annual clovers).
- Grazing management systems that maximize spring live-weight (LWG/ha) gain but enable the high quality forages to survive and thrive.
- Persistent grass species that respond to moisture after summer dry periods (Cocksfoot).
- Appropriate research information to allow farmers to develop management systems that maximize the benefits of dryland pasture species (Field days)!

Weather data summary - Wairarapa

Rainfall and evapotranspiration

The months from October 2015 to April 2016 were dry in the Wairarapa as highlighted by Figure 1.

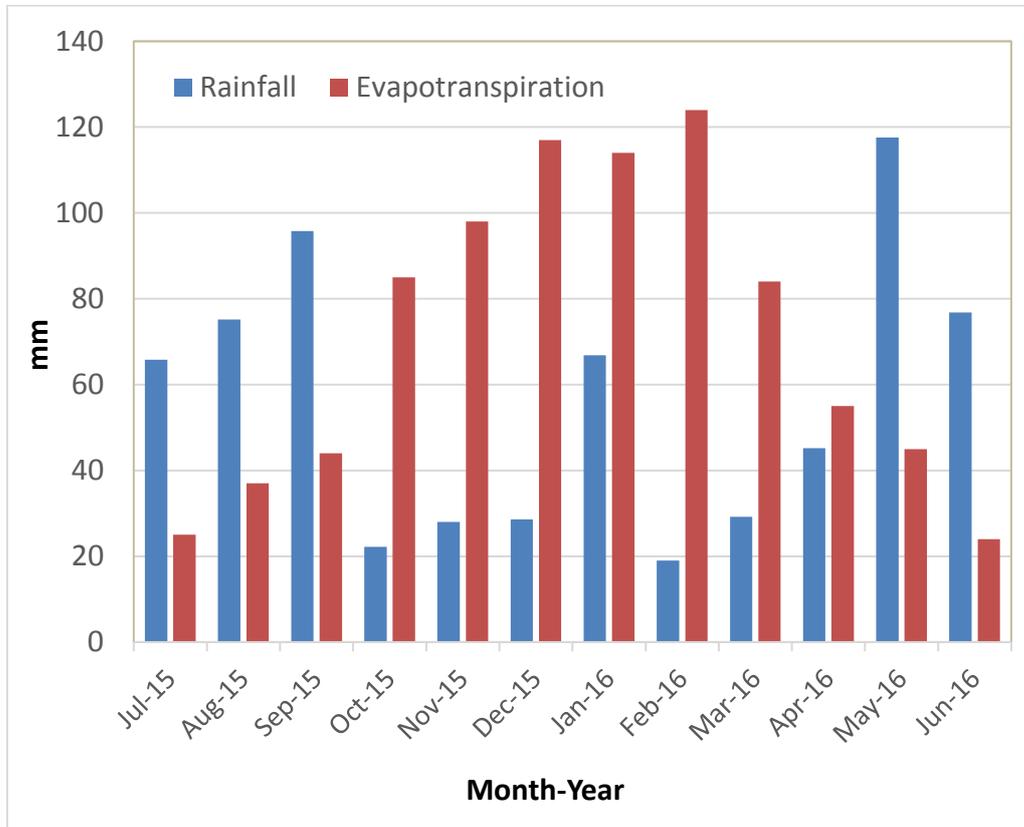


Figure 1: 2015-16 monthly amounts of rainfall and evapotranspiration, Glen Eden Farms Ltd (approx. 0.8 km from Tokaroa farm experimental sites).

The lack of rainfall, and therefore soil moisture, may have had the following effects:

- ♣ reduced dryland pasture growth
- ♣ delayed reestablishment of resident sub clover populations
- ♣ delayed and reduced germination and establishment of sown annual clovers

Sub clover germination is triggered by a significant rainfall event >20mm during the autumn. However there was no significant rainfall recorded here until late May when ongoing rainfall amounted to 88 mm over a 10 day period.

Clover & plantain cultivar plot map

	Plot no. Cultivar name	Plant type
Raceway	1. Narrikup	Sub clover
	2. Napier	
	3. Monti	
	4. Denmark	
	5. Coolamon	
	6. Antas	
	7. Woogenellup	
	8. Denmark	
	9. Antas	
	10. Napier	
	11. Narrikup	
	12. Woogenellup	
	13. Coolamon	
	14. Monti	
Raceway	15. Taipan	Balansa
	16. Bolta	
Raceway	17. Laser	Persian
	18. Lightning	
	19. Lusa	
Raceway	20. Arratas	Arrowleaf
	21. Cefalu	
Raceway	22. PG742	Plantain
	23. Boston	
	24. Tonic	
	25. N16PL3	
	26. Tuatara	
Raceway	27. Relish	Red clover
	28. Tuscan	
	29. TP22	
	30. Sensation	

Figure 2: Layout of the clover and plantain cultivar demo plots, Tokaroa Farm.

Note: Sub clover sown at 10 kg/ha; annual clovers, plantain and red clover were sown at 8 kg/ha.

Sub clover cultivars - Sub 4 Spring

Location: Tokaroa Farm, Martinborough.

Aim: evaluate subterranean clover cultivars that may be suitable for introduction to pastures through direct drilling in this environment.

Methods

- ♣ Sub clover seed sown in 3 x 20 m plots at 10 kg/ha on 21/4/16
- ♣ Two plots of each cultivar: Antas, Coolamon, Denmark, Monti, Napier, Narrikup and Woogenellup (Figure 2).
- ♣ Establishment numbers counted 6.3 weeks after sowing.
- ♣ Ground cover assessed at 16 weeks for sub clover, grass (predominantly a *Poa* species), weeds¹ and bare ground.
- ♣ At 19 weeks, 60% of each plot sprayed with 'Sequence' to control the grass.
- ♣ Herbage cut at 23 weeks – one 0.18 m² quadrat per plot – cage placed on a sub clover replicate prior to grazing same day (29/9/16, approx. 4 weeks ago, Figure 3).



Figure 3: Tokaroa Farm sub clover cultivar plots when the herbage was cut (29/9/16, Photo: Sonya Olykan).

¹ Main weeds = Cranesbill and Mouse-eared chickweed, minor = Sow thistle, nettle, amaranthus.

Results

♣ **Establishment:** Four of the sub clover cultivars – Antas, Coolamon, Narrikup and Napier - established well on this site with counts of 86 to 90 plants/m² (Figure 4).

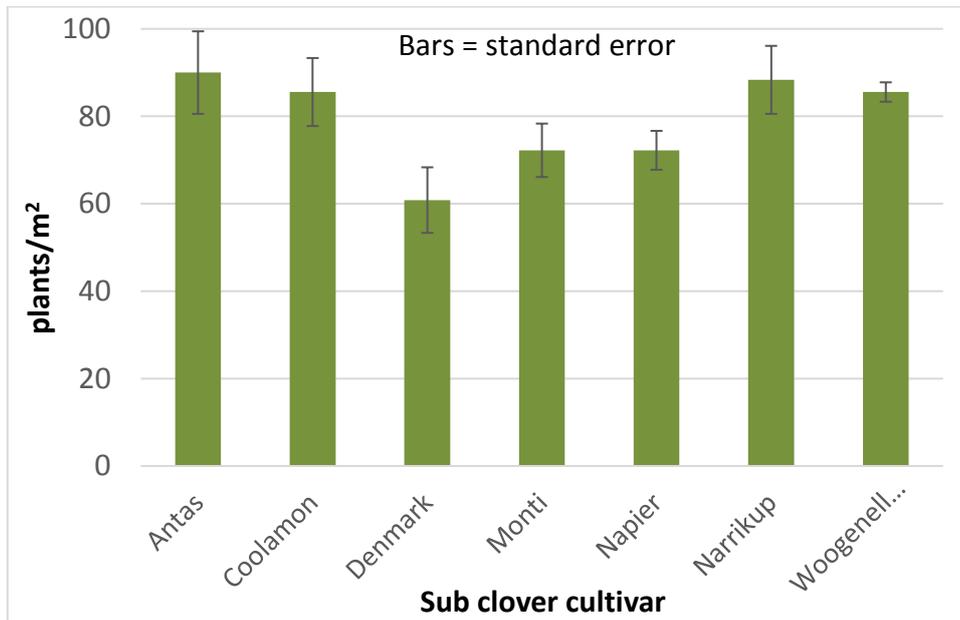


Figure 4: Sub clover cultivar establishment at Tokaroa Farm (4/6/16).

♣ **Ground cover:** By 16 weeks the sub clover cultivar Antas occupied 53% of the area. Cultivars Narrikup and Woogenellup occupied around 40% (Figure 5). The other four cultivars occupied 18 to 23% of the area and were dominated by grass (43 to 48%) with bare ground at 25%. Across the plots the weeds occupied 8 to 13% of the area.

The differences between the cultivars were more pronounced than expected, based on establishment data, suggesting that the Antas, Narrikup and Woogenellup plants were larger and with a larger leaf area were able to spread at this site and compete with the grass.

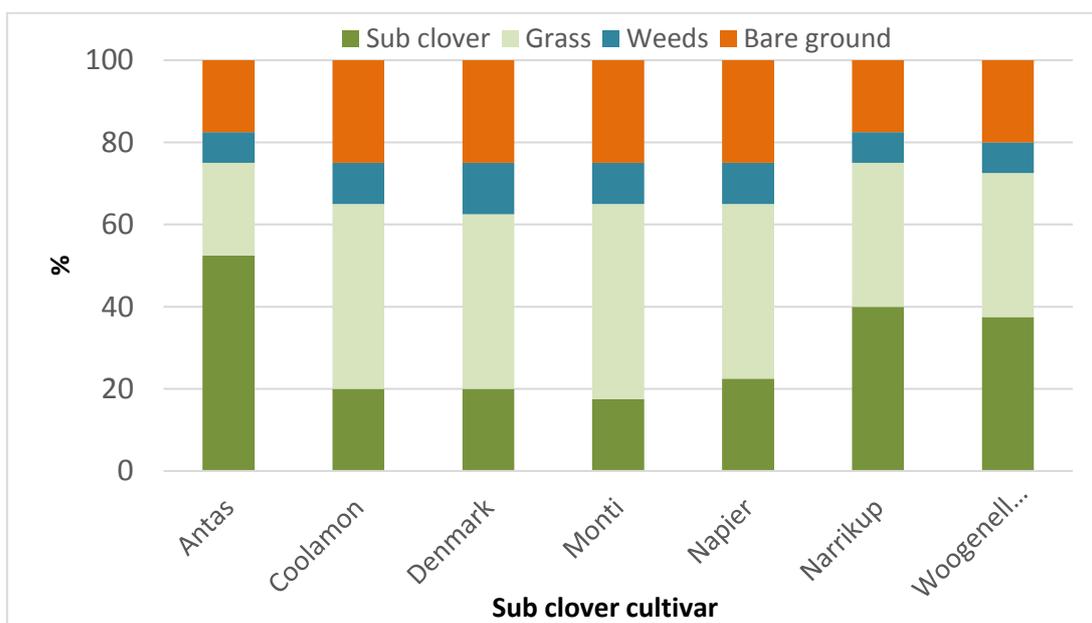


Figure 5: Ground cover % of sub clover cultivar plots, Tokaroa Farm (11/8/16).

♣ Dry matter production:

By 26 weeks Antas had grown the most providing 3300 kg DM/ha (Figure 6). Narrikup and Woogenellup produced 2800 and 2900 kg DM/ha, respectively. The other four cultivars produced 2100 to 2400 kg DM/ha. It is likely that the provision of weed control particularly benefitted these cultivars.

A cage was located on a replicate of each sub clover cultivar and the next day the area was opened up to the ewes and lambs to graze for 12 hours. The area has now been closed for nearly 4 weeks since the DM cut to allow regrowth.

The herbage under the cages represents the total amount of sub clover growth from the time of establishment.

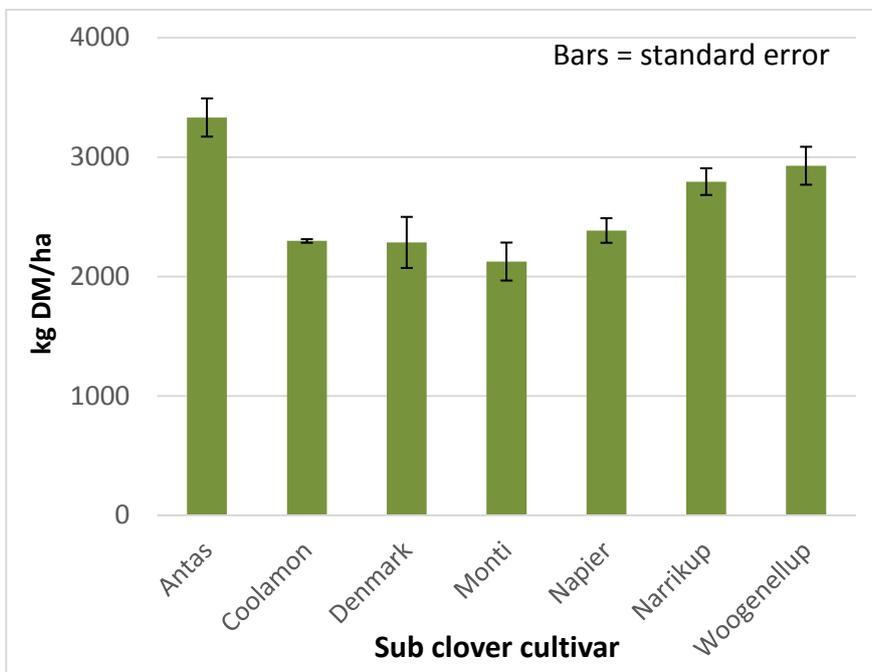


Figure 6: Dry matter production of sub clover cultivars, Tokaroa Farm (29/9/16).



Figure 7: Sub clover cultivar Antas. Height of measuring stick is 30 cm. (29/9/16 Photo: Sonya Olykan).

Conclusions

Three sub clover cultivars, Antas, Narrikup and Woogenellup, have shown promising establishment and dry matter production at Tokaroa Farm.

The sub clovers need to be spelled from grazing to allow flowering and seed set to ensure reestablishment next season.

For this experiment herbicide was needed to reduce the grass competition. Can competing weeds and pasture species be controlled with grazing?

Recommendations

The performance and persistence of the sub clover cultivars be investigated in a legume/plantain pasture.

Exclosure demonstration plots – Sub 4 Spring

Location: Tokaroa Farm, Martinborough.

Aim: To provide a farmer demonstration as to what happens to hill country pasture across a wide range of land classes with significant resident population of sub clover in it when spelled.

Methods – 2015 season

4 closing (spelling) treatments (see Figure 8):

1. Current management (no exclosure, i.e. surrounding paddock)
2. Closed for 3 weeks (Exclosure 2). Herbage samples taken on 20th October 2015.
3. Closed for 6 weeks (Exclosure 3). Herbage samples taken on 7th November 2015
4. Closed for 9 weeks (Exclosure 1). Herbage samples taken on 30th November 2015.

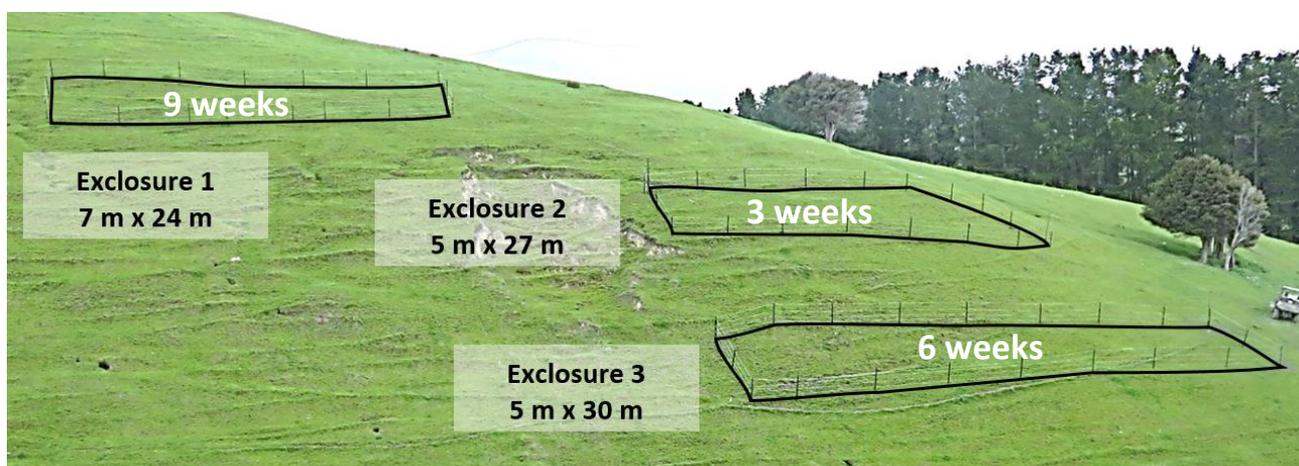


Figure 8: Layout and spelling times for the exclosure plots, 2015 season, Tokaroa Farm (Photo: Malcolm Macfarlane)

Results and discussion

Pasture and sub clover production in the exclosures

The amount of pasture dry matter increased between spelling weeks 3, average of 428 kg DM/ha, and 9 weeks with 2503 kg DM/ha (Figure 9). At 6 weeks there was 576 DM/ha.

After 9 weeks spelling there was a noticeable difference between DM production on the easy and steep slopes in the exclosure: 3193 kg DM/ha v. 1813 kg.

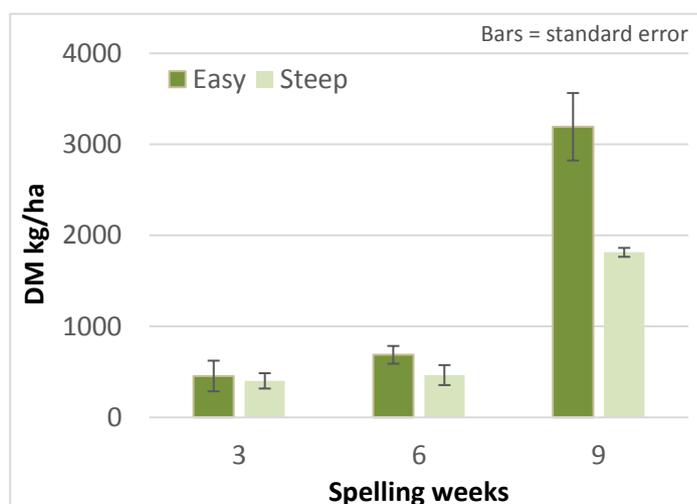


Figure 9: Effect of spelling weeks and slope type on pasture growth in the exclosure plots, Tokaroa Farm.

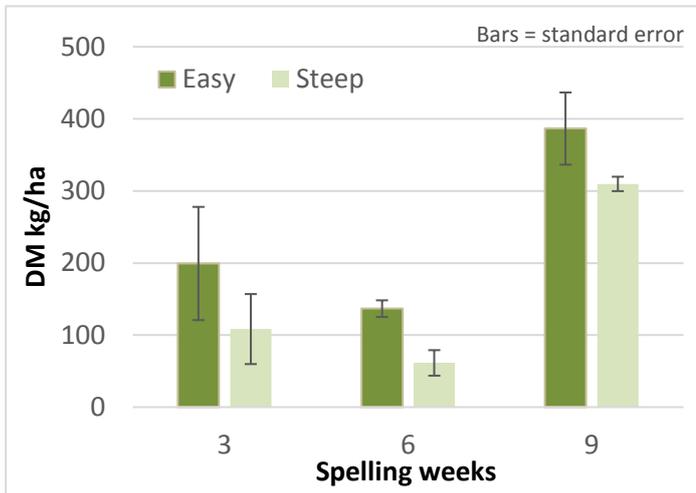


Figure 10 Effect of spelling weeks and slope type on sub clover growth in enclosure plots, Tokaroa Farm.

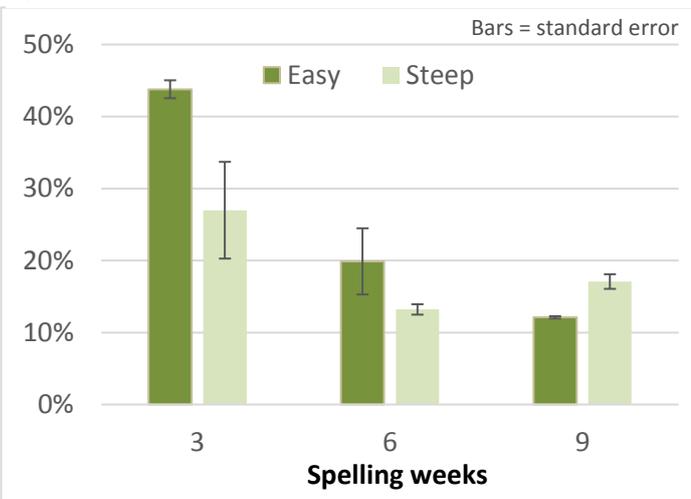


Figure 11 Effect of spelling weeks and slope type on the percent sub clover in the pasture of the enclosure plots, Tokaroa Farm.

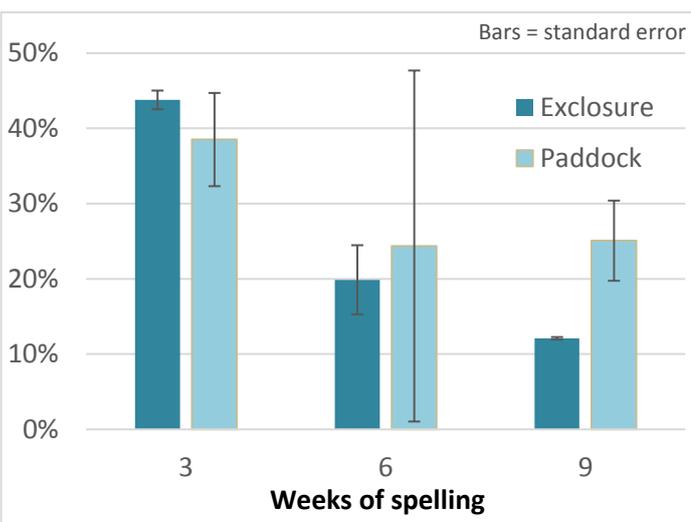


Figure 12 Effect of spelling weeks on the percent sub clover on the easy slopes in the pasture versus enclosure plots, Tokaroa Farm.

² The steep slope sampling sites in the paddock were chosen because they did not contain sub clover.

The results for sub clover DM alone are variable (Figure 10). The increase from weeks 3 to 9 was significant - 154 and 348 kg DM/ha respectively - but less pronounced compared to overall pasture production (Figure 9). Also the difference in sub clover production between the easy and steep slope at week 9 is much less pronounced - 387 compared to 310 kg DM/ha.

As pasture growth increased with spelling weeks the proportion of sub clover declined (Figure 11). This was especially noticeable on the easy slope where sub clover was 44% of the pasture DM weight at week 3 but only 12% by week 9.

There was less sub clover on the steep slopes and this declined from 27% at week 3 to 17% by week 9.

Sub clover in the enclosures compared to paddock, easy slope²

The only significant difference between the enclosure and paddock 'easy' slope sites occurred in week 9 when the proportion of sub clover was higher in the paddock where grazing had reduced the effect of grass competition on sub clover production (Figure 12).

Sub clover reestablishment in the exclosures

The reestablishment of sub clover was measured in early June 2016. The data suggests that 3 weeks of spelling greatly promotes sub clover reestablishment (Figure 13). However the week three exclosure also had the highest sub clover component (Figure 11) and because the treatments were unreplicated it is difficult to know what effect exclosure location has had. In addition there were no time zero measurements to quantify sub clover populations to start with.

Overall the reestablishment counts for sub clover were good given the poor autumn rainfall.

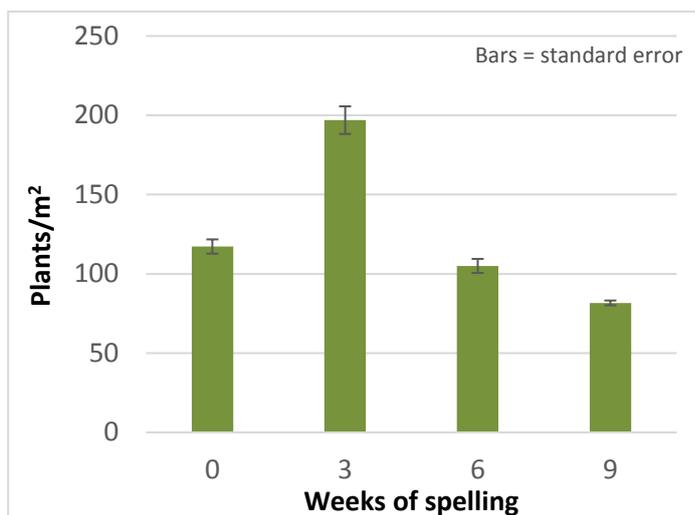


Figure 13 Effect of spelling weeks on the reestablishment counts of sub clover in the exclosure plots, Tokaroa Farm.

Conclusions

Because there was only one replicate of each spelling treatment it is not possible to identify if site factors, associated with the position of the exclosures on the slope, or variation in sub clover populations affected the results.

Another consideration is the low rainfall in October 2015 (see Figure 1) impacting on pasture DM production between spelling weeks 3 and 6.

Recommendations

This experiment has been redesigned for the 2016 season to address the lack of replication and reduce variation issues shown in the data:

- ♣ Each exclosure has been divided in half with one half being spelled for 4 weeks and the other for 8 weeks. This provides a replicate of each spelling treatment at each slope position.
- ♣ The experiment started on 29/9/16 and the 'Day 0' sub clover populations were assessed inside the exclosures and in the control paddock.

Herbicides and sub clover cultivars for hill country

Location: Glenside Farm, Taratahi.

Aim: To provide a farmer demonstration of cultivars and herbicide options for oversowing on hill country.

Methods

Herbicides: 6 treatments applied by helicopter down the slope (no replicates) in spring (S, applied on 31/11/15) and/or autumn (A, applied 19/4/16) aimed to either provide a full pasture kill or suppress the pasture:

- ♣ Control: No spray
- ♣ HiG-S: Roundup at 3 L/ha plus 40 g/ha Hammer in 100 water litres/ha (full kill)
- ♣ HiG-SA: as above plus an autumn application (full kill)
- ♣ HiG A: Roundup at 3 L/ha plus 40 g/ha Hammer in 100 water litres/ha in autumn (full kill)
- ♣ LoG-A: Roundup at 0.7 L/ha in 100 water L/ha in autumn (sward suppression only)
- ♣ Para- A: 0.8 L/ha FLASH® (contains 250 g paraquat/L) with low water rate (60 litres/ha) in autumn (sward suppression only)

Sub clover cultivars –Antas, Coolamon, Denmark, Narrikup and Woogenellup broadcast sown on 24/4/16 with a spinner at 20 kg/ha.



Figure 14: Looking down the slope 2 weeks after application of the HiG-S herbicide and the weed and pasture kill was good. Evidence of spray drift to the east (right). Glenside Farm, Taratahi (*Photo: Malcolm Macfarlane*).

Herbicide treatments differed in their effectiveness

Herbicide treatment significantly affected ($p < 0.001$) pasture ground cover components: % green, %dead and %bare ground.

Most effective treatment was a high rate of glyphosate applied in spring (HiG-S, Figure 15). The proportion of green was 12% compared to 40% in the control.

A high rate of glyphosate in autumn (HiG-A) significantly reduced the green component to 23%.

HiG-S significantly increased the proportion of bare ground from a control level of 13% to 32 and 34% respectively. This had positive benefits for resident sub clover reestablishment (see Figure 17) but provided an opportunity for weed invasion, particularly mouse-eared chickweed.

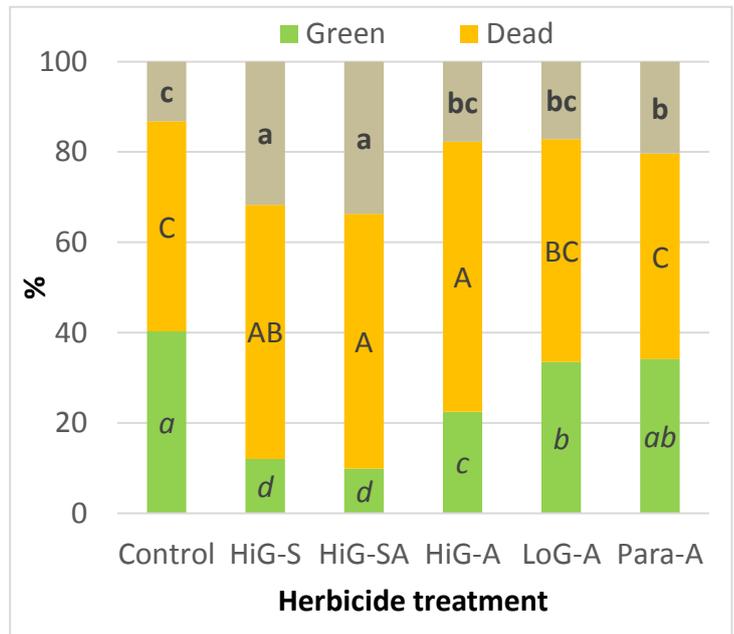


Figure 15: Herbicide effect on % ground cover at Glenside Farm, Taratahi (assessed 9/5/16, Fisher's Protected LSD (5%).

Autumn herbicide improved sown sub clover establishment

Autumn applications of low glyphosate (LoG-A), high glyphosate (HiG-A) or paraquat (Para-A) resulted in the establishment of about 40 sown sub clover plants/m² (Figure 16).

A control area was not counted for sown sub clover establishment.

Sub clover cultivar type had no effect on establishment and there was no interaction between the herbicide and cultivar.

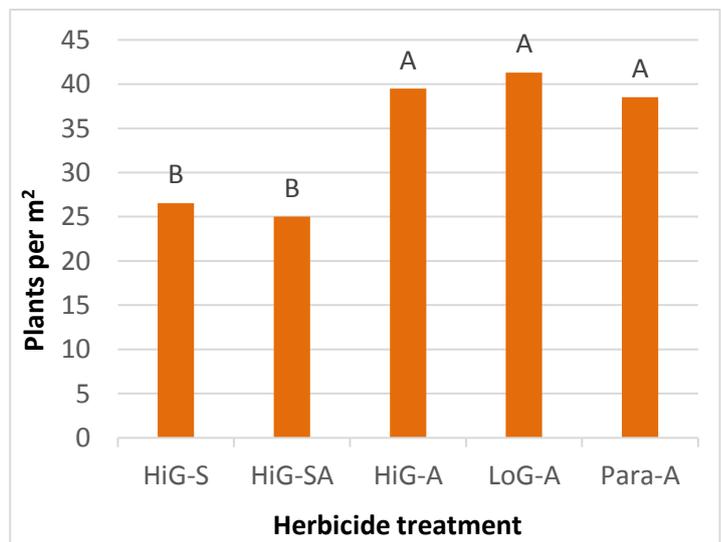


Figure 16: Herbicide treatment affected sown sub clover establishment at Glenside Farm (Fisher's Protected LSD (5%).

Spring herbicide improved resident sub clover establishment

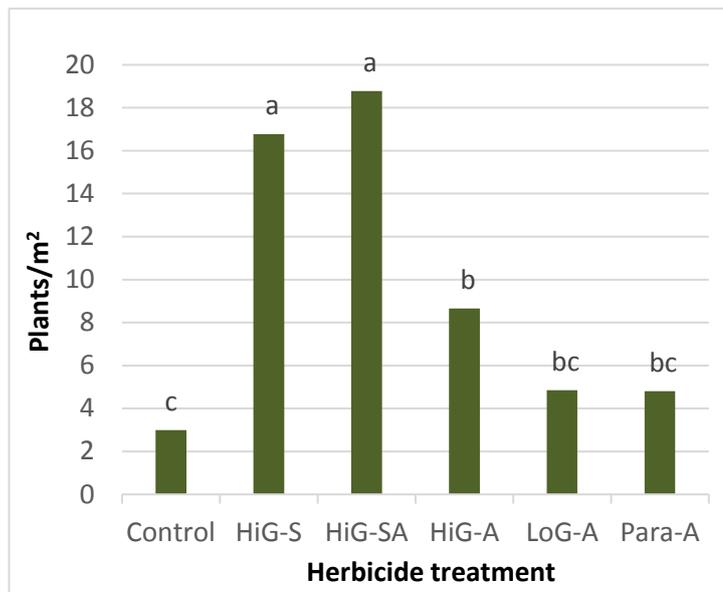


Figure 17: Herbicide treatment affected resident sub clover establishment at Glenside Farm (Fisher's Protected LSD (5%).

In the control there were three established resident sub clover plants/m² (Figure 17). The numbers were highest, at 17 to 19 plants/m², in plots with the spring application of glyphosate at a high rate (HiG-S and HiG-SA).

Resident sub clover establishment happened earlier than that for the sown cultivars (Figure 18). The autumn herbicide application was too late to aid resident sub clover establishment so the effects of the autumn herbicides were no different to the controls (except for applying a high rate of glyphosate).



Figure 18: Photos taken on the same day (8/6/16) at the Glenside Farm experiment. A) Resident sub clover established much earlier in the spring herbicide treatment. B) Close-up of germinated sown sub clover at the cotyledon stage (Photos: Annette Litherland).

Conclusions

Sown sub clover: Results highlight the effectiveness of autumn herbicide applications to suppress the competing pasture (grass) and provide the opportunity for sown sub clover to establish. However ongoing pasture competition needs to be managed with grazing. The sowing rate of 20 kg sub clover seed/ha equates to about 300 seeds/m².

When oversowing seed, germination and survival is usually less than 10%. At Glenside sub clover seedling counts above 30 plants/m² indicates that the oversowing was a success.

Resident sub clover: There are already viable resident sub clover populations on Glenside Farm (see Figure 19 for examples) and in the dryland hills of the Wairarapa but 'traditional' grazing practices have resulted in the residents becoming small leaved and prostrate to survive. At Glenside the spring application of herbicide promoted resident sub clover populations by eliminating the pasture competition. However it also resulted in a significant weed issue that required further action.

The challenge is to develop a grazing management regime that will improve the proportion of the resident sub clover in existing pastures, particularly on the drier north-facing slopes, or allow the establishment of oversown cultivars proven to be productive in the Wairarapa.

Recommendations

That a case study be undertaken to extend this research to suitable production areas on Glenside Farm and investigate the feasibility of:

- A) using grazing management (e.g. spelling paddocks during flowering and seed set) to promote the reestablishment and of resident sub clover and improve population numbers.
- B) identify ways of introducing persistent and productive sub clover cultivars that will improve the legume content of pasture on an ongoing basis.



Figure 19: Two types of resident sub clover plants taken from Glenside Farm are being grown at Lincoln University for identification purposes (Photos: Sonya Olykan).

Poukawa Research Station – Hawkes Bay

Effects of sowing dates (temperature and photoperiod) on sub clover cultivars

Carmen Teixeira, Derrick Moot

Sub4Spring team – a collaboration between Lincoln University and On-Farm Research at Poukawa

Background

Subterranean clover (sub clover)

- Autumn / winter legume to complement other legumes.
- High quality feed early in spring and self-reseeding legumes with high N contribution.

Early plant growth/development and flowering time are important aspects for cultivar choice (fit for the environment) and management (grazing strategies and re seeding).

Problem/opportunity: new improved sub clover cultivars are available on the New Zealand (NZ) market. All selected for Australia production systems. Cultivars differ immensely in terms of maturity, plant form and yield potential. What can we expect of these cultivars growing in temperate NZ?

The experiment

Six cultivars (early, medium, late; based on Australian data) were selected: ‘Narrikup’, ‘Monti’, ‘Woogenellup’ (considered resident), ‘Antas’, ‘Denmark’ and ‘Leura’. The same experiment is at Field Research Centre, Lincoln University, Canterbury (see Table 3).



Sowing date code	Date
S1	19 February 2016
S2	30 March 2016
S3	30 May 2016
S4	05 July 2016
S5	24 August 2016
S6	11 October 2016
S7	scheduled November 2016
S8	December 2016

Figure 20: Overview and Sowing dates (S) used to quantify phenological development of six subterranean clover cultivars of the sub clover cultivar experiment at Poukawa Research Station Hawkes Bay, New Zealand. Pure stands were irrigated and not grazed until flowering. Targeted plant population: 2200 plants/ m².

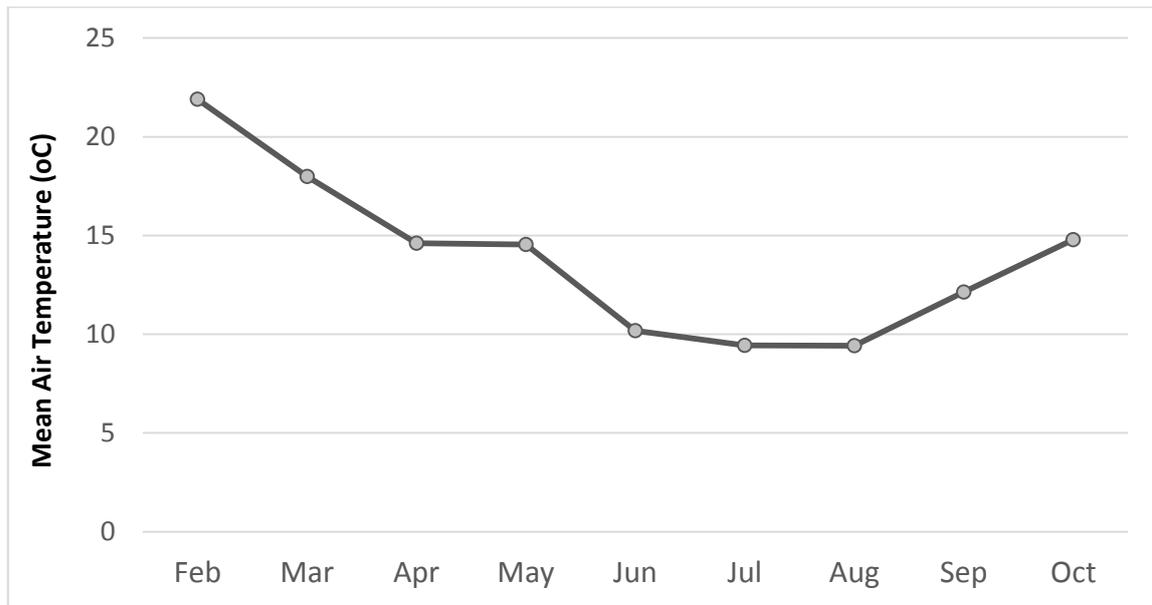


Figure 21: Mean air temperature (°C) from February 2016 to October 2016, Hastings weather station, Hawkes Bay, NIWA, 2016.

Preliminary results

A. Sowing dates and plant development

- from sowing to 5 trifoliate stage

It took about a week for seedlings to emerge when sown in March (Table 1). Emergence was delayed (~ 2 weeks) with the low late autumn and winter temperatures. Overall the subs required 130 degree days (°C/d) for emergence. Emergence was irregular in February (S1) due to uneven irrigation and weed competition (*) and therefore not used for establishment estimations.

Table 1: Average days after sowing (DAS) , mean air temperature (T, °C) and estimated thermal time (TT°Cd) to 50% emergence and to 5 trifoliolate leaf stage for six sub clover cultivars sown in 2016 at Poukawa Research Station, Hawkes Bay.

Code	Date	Emergence			5 Trifoliate stage		
		DAS	T (°C)	TT(°Cd)	DAS	T (°C)	TT(°Cd)
S1	19 February	17	20.0	*	*	*	*
S2	30 March	8	16.0	132	37	9	549
S3	30 May	15	9.5	142	70	6.5	670
S4	05 July	14	9.3	127	58	10	554
S5	24 August	10	12.0	119	NA	NA	NA

*data were not considered for estimation of the thermal time to emergence due to irregular field conditions. NA= data collection ongoing.

Seedlings reached a “safe graze/ spray” stage of 5 trifoliates earlier when sown in March (~ 37 DAS). Late sowings (May/ July) resulted in slow growth and plants needed > 60 DAS to produce 5 trifoliates. So far, the preliminary analysis show an average thermal requirement of 580 °Cd requirement to produce 5 trifoliates (equivalent of an average phyllocron of 77 °Cd/leaf). These values are 30 % higher than previous published data, which suggests a genotype/environment effect. Further data and analysis will reveal more about these “new released” cultivars and strategies to manage them effectively. Details of sub clover development phases are available in the sub clover guide (page 3).

- **from sowing to runners and flowers**

Table 2: Average days after sowing (DAS) , mean air temperature (T, °C) and estimated thermal time (TT°Cd) to reach 50% of runner extension and initial flowering*** for six sub clover cultivars sown in 2016 at Poukawa Research Station, On- farm Research, Hawkes Bay.**

Code	Date	Runner extension **			Flowering ***		
		DAS	T (°C)	TT(°Cd)	DAS	T (°C)	TT(°Cd)
S1	19 February	*	*	*	204	11.6	2600
S2	30 March	80	14.0	1039	162	12.0	1880
S3	30 May	90	11.0	860	NA	NA	NA

** Visible runner with more than 20 mm length. See more about runners and flowers on the sub clover guide (page 7).

*** Flowering is variable among the cultivars: e.g. ‘Monti’ and ‘Narrikup’ being consistently early throughout the observations at Lincoln and Poukawa sites. NA= data collection ongoing.

About the cultivars:

A visual evaluation of the plants at the vegetative phase (45 DAS) is presented in Figure 22. Plots were scored according to a vigour scale (10 equals =excellent = healthy plants, high sub clover coverage, low presence of weeds).

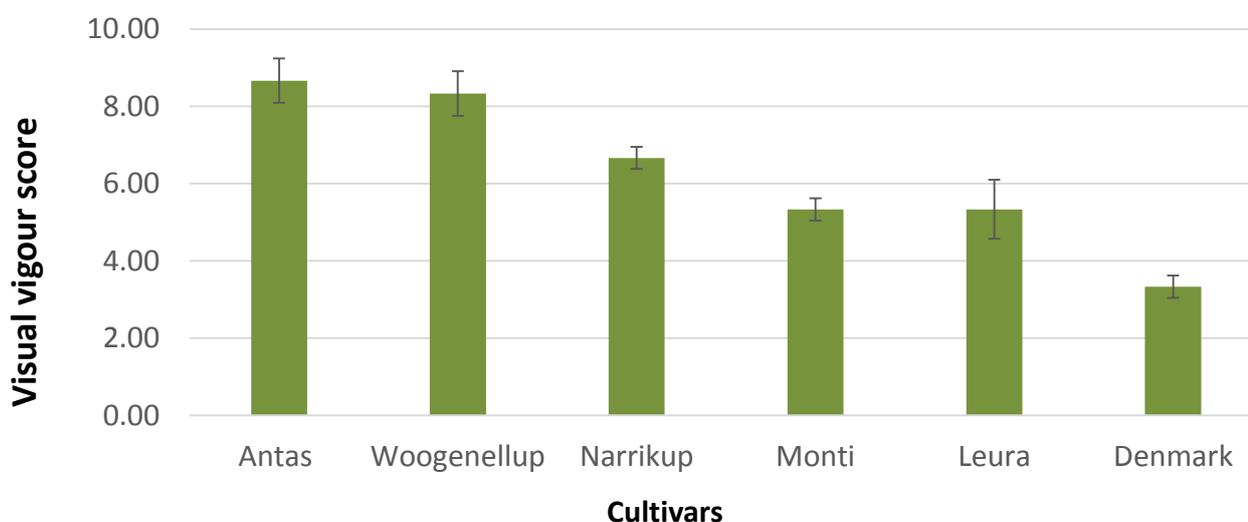


Figure 22: Visual plant vigour scores (10 = excellent; 0= poor) of sub clover cultivars sown on 30 March 2016 and scored 45 DAS, at Poukawa Research Station, Hawkes Bay, New Zealand.

Accumulated Dry matter: from sowing to flowering (preliminary data from Lincoln University experimental site)

Table 3 shows dry matter yields and estimated growth rates taken from selected sowing dates at the Field Research Centre area during 2016 and 2015. The pure stand (~ 2000 plants/m²) small plots were irrigated and cut only once near flowering to evaluate genotype potential and performance of the six sub clover cultivars.

Table 3: Sub clover cultivars, average DM yields (kg /ha) and growth rates recorded at Field Research Centre experimental area, Lincoln University, New Zealand.

Cultivar	Mean kg DM/ha	Estimated growth rates kg DM/day		
		2016 Sown : Mid Feb Cut: Early Sept	2015 Sown: late July Cut : early Dec	2015-2016 Sown: early Nov Cut: Mid Feb
Antas	11089	37	36	204
Narrikup	8120	32	24	156
Monti	8077	34	15	195
Wooгенellup	5373	26	30	85
Leura	4604	18	16	62
Denmark	3370	17	20	38

The plants which grew during November 2015 – February 2016 were near optimum conditions: temperatures ~ 17.5 °C and benefited from exceptional rain in Canterbury during December 2015 and January 2016.

- ‘Antas’ has produced more dry matter (>10000kgDM/ha) in this experiment and our results are consistent with other experimental sites (Ashley Dene, Cave). This sub clover has large seeds, with large leaflets and good early seedling vigour.
- In well managed small plots ‘Monti’ and ‘Narrikup’ produced 8000 kg DM/ha, which represents about 200 kg/ha fixed atmospheric nitrogen.

General practical sub clover tips!

- Consider high sowing rates at establishment (> 10 kg seeds/ ha) to ensure high herbage/ seed yields and ensure future re seeding on your pasture!
- The more biomass produced, the more Nitrogen it is fixed. Rules of thumb (25 kg/ha N per 1t DM).
- Earlier flowering cultivars, e.g. ‘Monti’ and ‘Narrikup’ tend to grow more dry matter early, while late flowering ones (e.g. ‘Leura’ will make most of late rains).

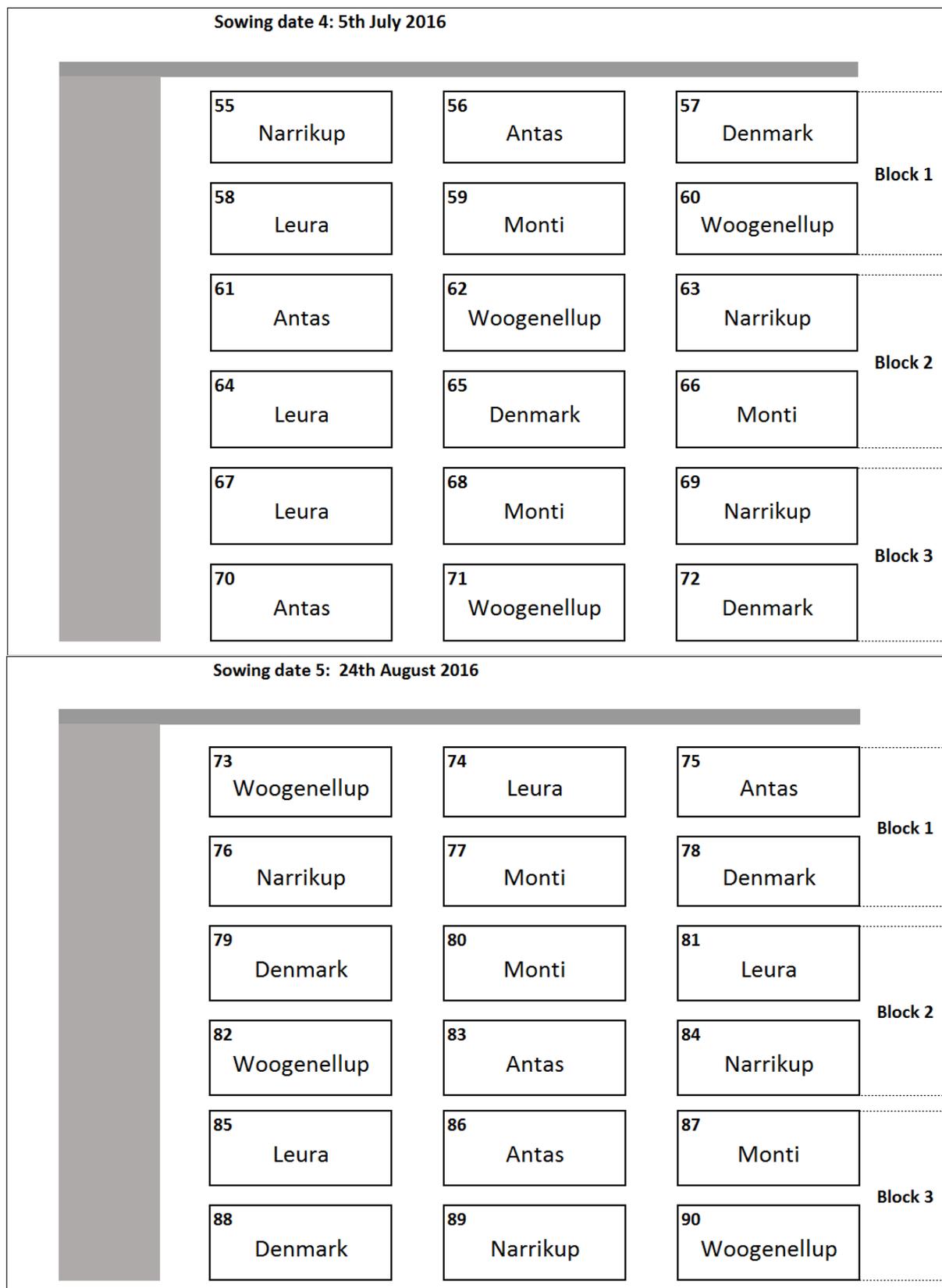


Figure 23: Layout of sub clover cultivar plots for two of the sowing dates - 5/7/16 and 30/8/16.



Figure 24: Photos of the Poukawa sub clover experiment. A = overview of the experimental area, B = close up of the sub clover experiment from sowing date 1 (S1) to sowing date 4 (S4) (Photos: Noel Smith).

Ashley Dene Dryland Pastoral Experiments

- Farm purchased in 1909.
- Consists of Home Block = 47.9 ha,
Cemetery Block = 103.9 ha
Main Block = 204.9 ha – now dairy
- Soils on Home and Cemetery Blocks: Lowcliffe moderately deep, Lowcliffe stony, Ashley Dene deep and Lismore stony soils.

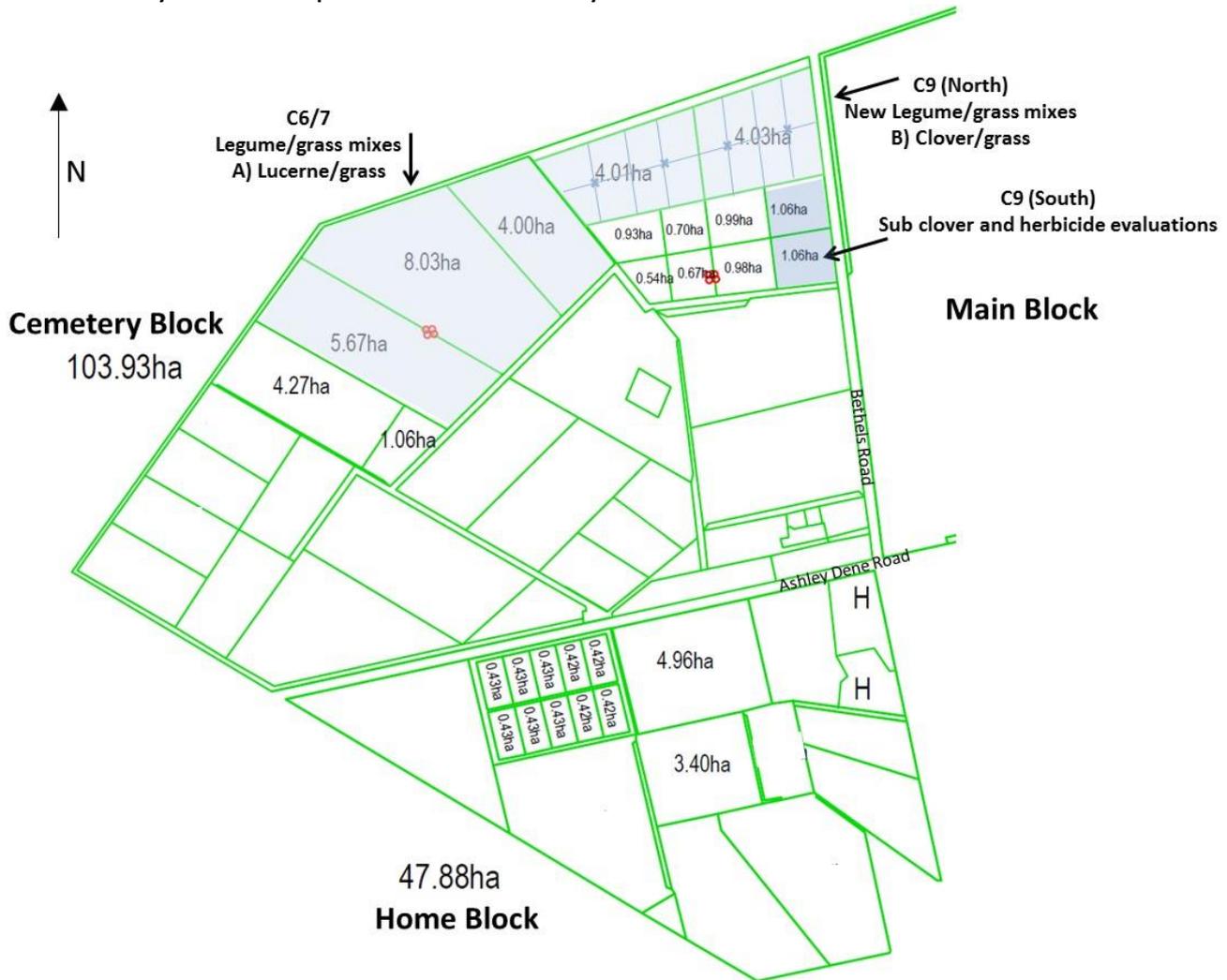


Figure 25 Map of Home and Cemetery Blocks at Ashley Dene Farm, Canterbury. Shaded areas are active experiments monitored for P21.

Pastoral 21

“This work was undertaken as part of Phase II of the Pastoral 21 Programme, funded by the Ministry for Business, Innovation & Employment; DairyNZ; Beef + Lamb NZ; and Fonterra, and Ministry for Primary Industries, Sustainable Farming Fund.”



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Previous Research Results

MaxClover (2002 – 2012)

Pasture composition:

- Lucerne monocultures remained >90% pure due to the winter weed control program.
- In the cocksfoot pastures the originally sown grass and companion clover species disappeared from the pasture at about 3% per year (Figure 26).
- Ryegrass and white clover were lost at a rate of 10% per year in these dryland grazed pastures (Figure 27), probably due to grass grub.

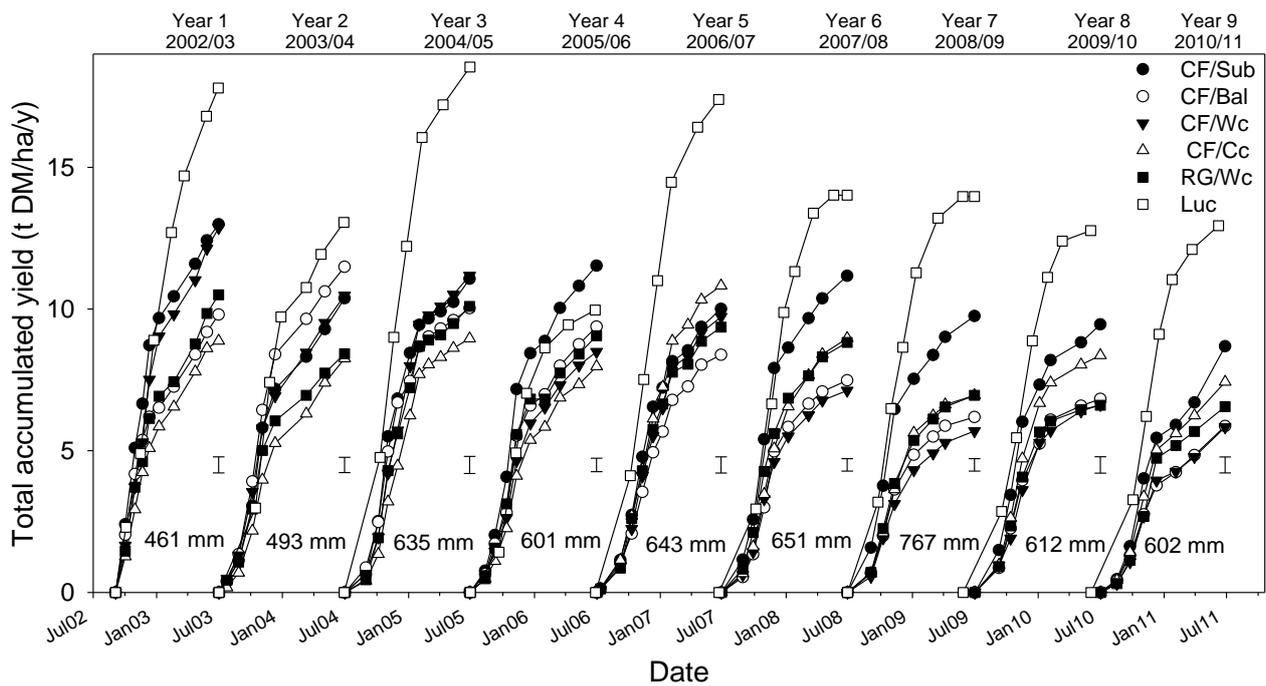


Figure 26 Total annual accumulated DM yields of six dryland grazed pastures at the 'MaxClover' grazing experiment at Lincoln University over nine years.

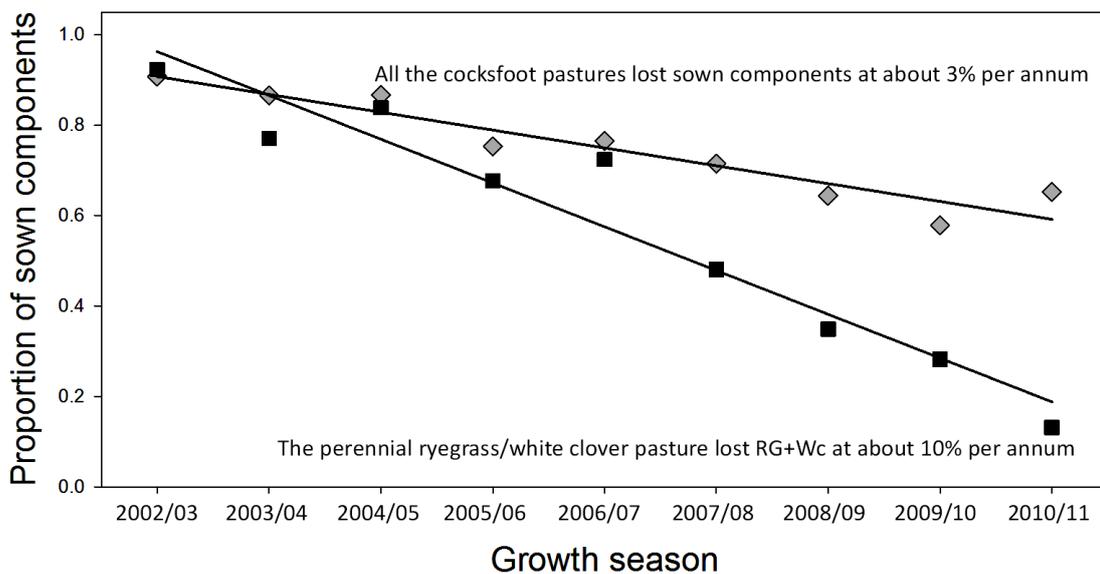


Figure 27 Rate of loss of the originally sown pasture components (grass+companion clover) from the five grass based dryland pastures at the 'MaxClover' grazing experiment at Lincoln University.

Yield of four grasses under summer dry conditions

Shirin Sharifiamina
Email: Shirin.sharifi@lincolnuni.ac.nz

Supervisor: Prof. Derrick Moot

The Problem: Perennial ryegrass persistence is limited under dryland conditions.

Comparative studies of the effects of nitrogen and severe drought on the production of cocksfoot, tall fescue, brome and perennial ryegrass under summer dry conditions are limited.

Treatments:

Species	Cultivar	Sowing rate (Kg/ha)	Nitrogen	Sowing date
Per. Rg	<i>Stellar AR1</i>	20	Full and 0 N	10/10/2014
Cocksfoot	<i>(SFR36-009)</i>	10		
Tall fescue	<i>Finesse Q</i>	25		
Brome	<i>Bareno</i>	35		

Two soil types:

Ladbrooks (Peaty Orthic Gley soil) and **Ashley dene** (Lismore Stony silt loam soil) with high and low water holding capacity.

Measurements:

- Seedling germination, shoot and root biomass
- Botanical composition
- Dry matter production (DM)
- Soil water extraction
- Light interception
- Canopy temperature

Main results

Establishment year (2014/15):

- Oct 2014- June 2015, no significant difference in DM at Ashley Dene (1.7-2.7 t/DM/ha) or Ladbrooks (6.8-8 t/DM/ha).

Second year (2015/16):

- At Ladbrooks, DM production of all grass species in +N (~20 t DM/ha/yr) was approximately double –N (~10 t DM/ha).
- N applied at Ashley Dene, did not increase DM yield of tall fescue, brome and perennial ryegrass.
- For cocksfoot +N yield was ~2.5 t DM/ha greater than perennial ryegrass, brome and tall fescue under severe drought conditions.

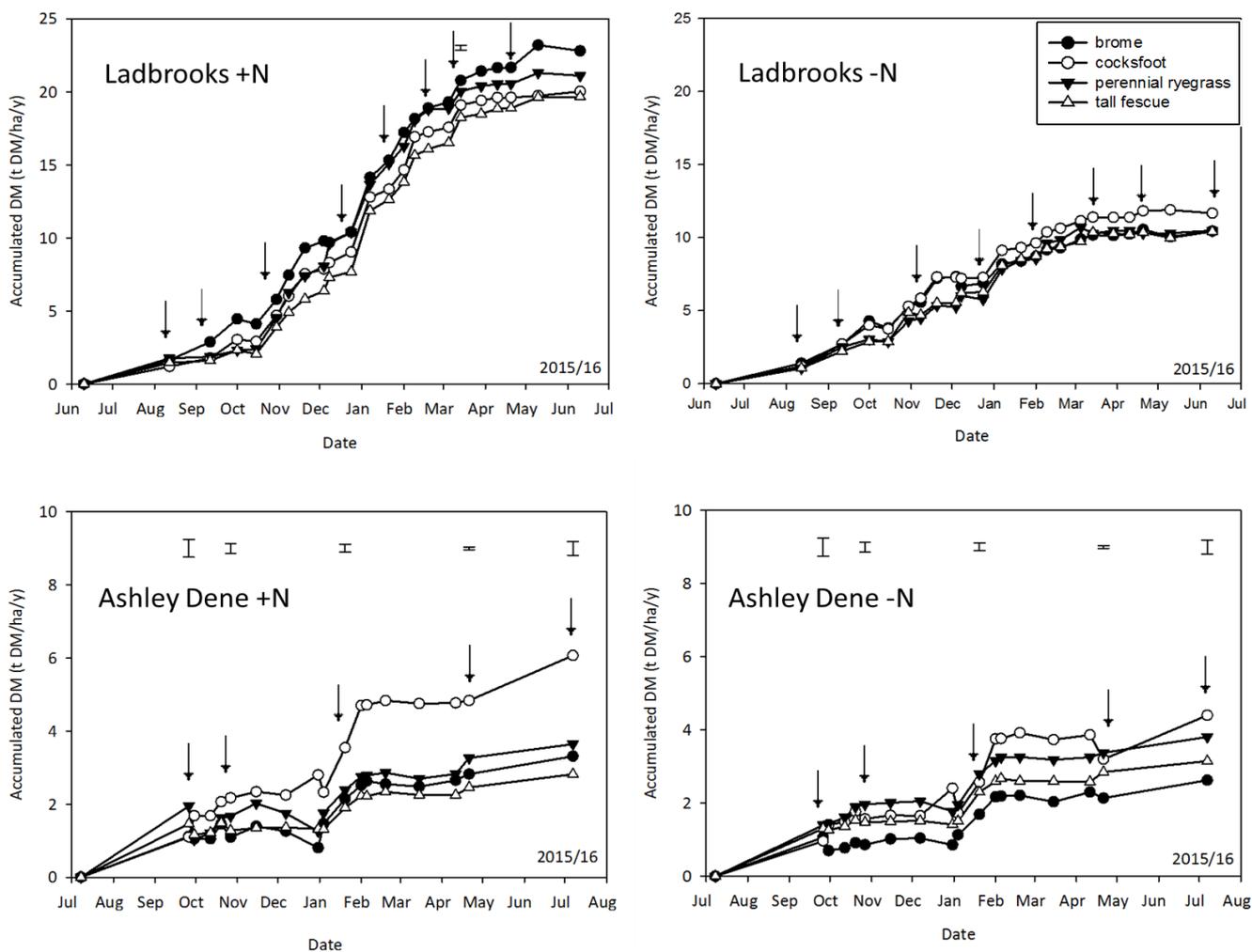


Figure 28: Accumulated DM production of brome, cocksfoot, perennial ryegrass and tall fescue over time, in 2014-16 at Ladbrooks and Ashley Dene, Canterbury, New Zealand. Treatments are +N and –N. The error bar is the highest SEM when species treatments were different ($p \leq 0.05$) on DM production. The arrows indicate a destructive harvest.

Note: nitrogen application in +N treatments occurred after the destructive harvest.

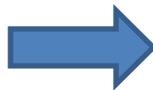
The Solution:

- All species were suitable and have produced the same amount of DM when soil moisture was available on a deep peaty soil at Ladbrooks.
- Under severe moisture stress cocksfoot was the most productive and responded quickest to summer rainfall when it had N available.
- Pasture persistence remains to be quantified over the next two years.

Ovulation rates of ewes following removal from oestrogenic lucerne for different durations

PhD candidate Rachel Fields - Prof Derrick Moot, Ass. Prof Graham Barrell

- Lucerne can contain an oestrogenic compound called coumestrol.
- Coumestrol is produced in response to fungal pathogens. We have found no response to development stage or water stress.
- Coumestrol can lower the fecundity of ewes if they eat lucerne containing high levels during the mating period.
- This results in fewer multiple births and more singles, decreasing lambing rates.

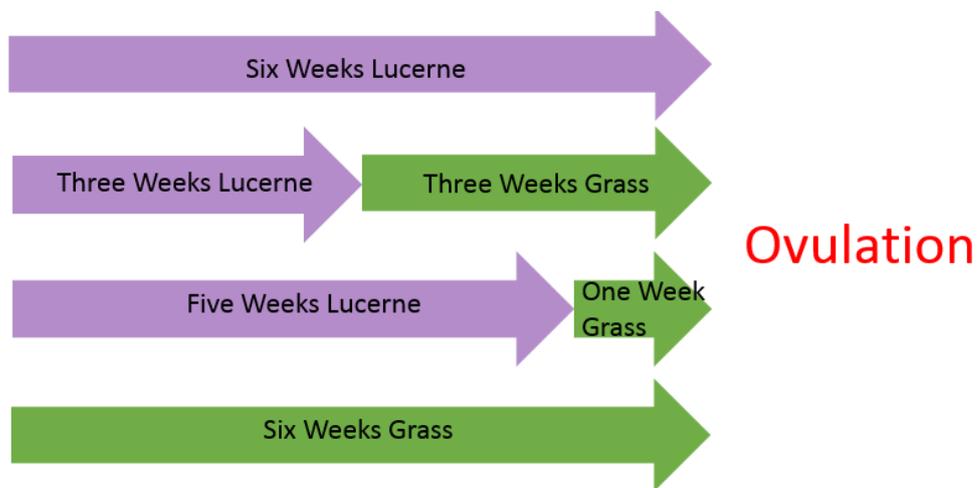


Problem

Suppression of fecundity is temporary and can be mitigated by removing the animals from lucerne. How long before mating should they be removed?

Methods

- **2-tooth Ewes (~18 months)**
- **15 ewes per treatment**
- **Four grazing treatments**
- **Blocked by live weight**
- **Break-fed with back fence**



Measuring Ovulation Rate

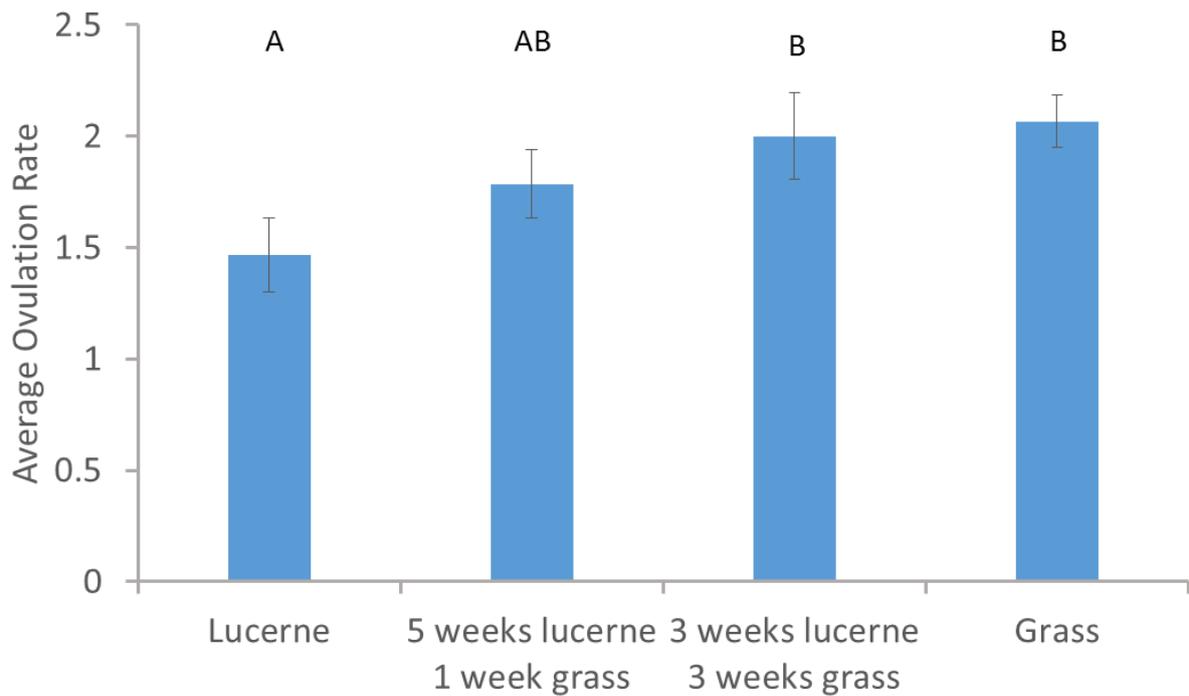
Ovulation occurs while the ewes are in oestrus (heat). During the autumn, on average ewes will ovulate every 17 days. To measure the ovulation rate the ewes must be synchronised.

- Controlled internal drug release (CIDR) devices were used for 12 days.
- Ovulation occurred 24-48 hours after CIDR removal.
- For each egg that is released from the ovary a corpus luteum develops.
- Corpus lutea were counted by laparoscopy (key hole surgery) a week after ovulation.

Ovulation Rate Results

No effect of grazing treatment on live weight:

- 5.3 kg gain over six weeks.
- Average weight of 66.3 ± 0.97 kg at ovulation



*Means that do not share a letter are significantly different (Fisher's LSD).

Removal of ewes from lucerne three weeks prior to ovulation (oestrus) prevented suppressed ovulation rate.

Solution: Applying to farm systems

Ewes can be synchronised with teaser rams so that they ovulate at a similar time, and thus the time on lucerne can be maximised.

- Teaser rams cause ovulation and a silent heat within three or four days. This is followed by a cycle every 17 days through the breeding season until pregnancy.
- Remove ewes from lucerne, put with teaser rams for two weeks, and then swap for entire rams.
- This will give ewes approximately three weeks off lucerne before ovulation.

If teasers are not used:

Remove ewes from the lucerne two weeks before the rams are introduced. This will give over half of the ewes at least three weeks off lucerne before they ovulate.

Disclaimer- *Despite these results, if there is no good alternative to lucerne it is better for the animals to be gaining/maintaining weight on lucerne than losing weight on low quality, dead pasture.*

There is a strong, well-documented, relationship between live weight and ovulation rate.

Cemetery Block – MaxAnnuals

Dr Alistair Black Mr Dick Lucas Prof Derrick Moot

The Problem: Shortage of feed available in early spring for set-stocking and before lucerne is ready to be grazed.

Clover/grass mixes (Year 1)

C9A(N) + C9B(N)

- Established in paddocks C9A(N) and C9B(N) (total area 8.04 ha)
- Four pastures, replicated four times, were established in an RCB between 26 Mar and 16 Apr 2013. Two replicates were sown on each date.
- Paddocks are ~0.5 ha in size, except Paddocks 1 (0.6 ha) and 9 (0.3 ha).
- Soils are stony and have variable depth to gravels, typical of a floodplain. They are classified as Lismore stony soils over most of the site.
- Grazed by hoggets in spring of 2013 and by ewes with lambs in spring 2014.
- On 10 Oct Reps 2 and 4 were closed. Reps 1 and 3 were closed on 18 Oct 2013.

C9N grazing experiment - Cocksfoot v ryegrass x fescue with sub clover and ± balansa clover

4 reps with Reps 1 & 2 [C9A(N)] with a RG/Sub background and Reps 3 & 4 [C9B(N)] with a brassica and lucerne background

- Pastures 1. CF + Sub (CF/Sub)
 2. CF + Sub + Balansa (CF/SB)
 3. RG/Fescue + Sub (RF/Sub)
 4. RG/Fescue + Sub + Balansa (RG/SB)

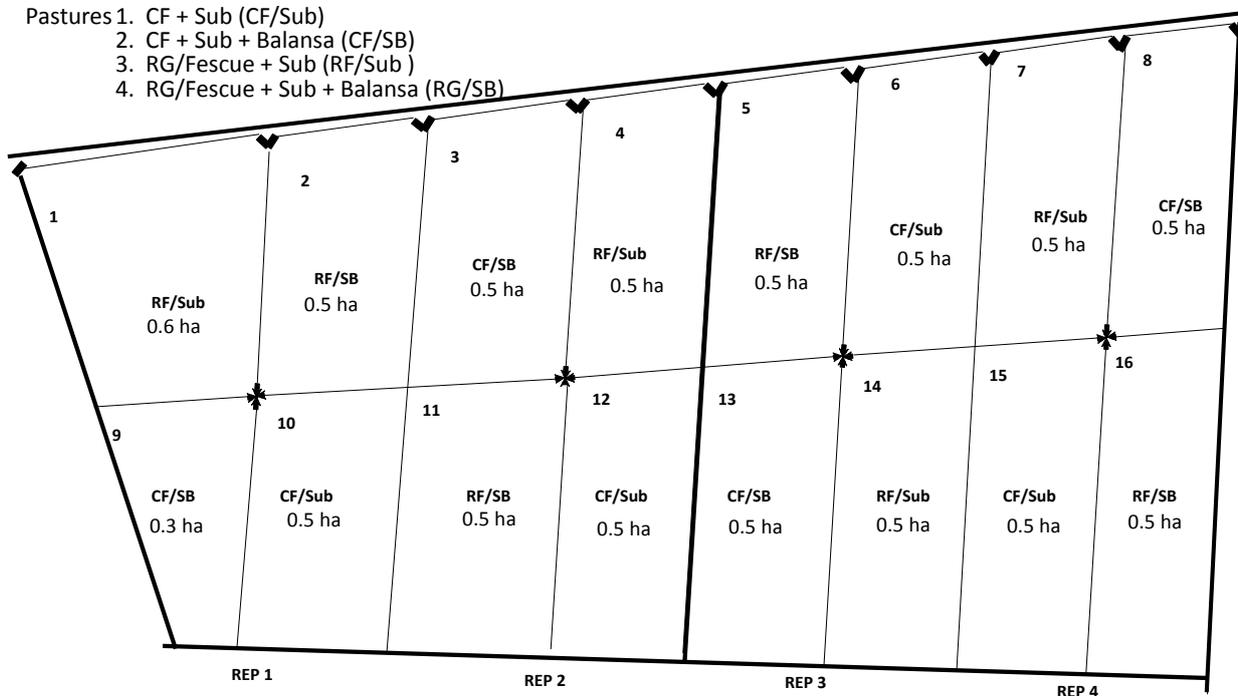


Figure 29: Experimental plan of the MaxAnnuals clover based pastures in C9A&B(N) at Ashley Dene, Canterbury.

Table 4: Sowing rates (kg/ha) of species and cultivars used in the dryland pastures established in C9N(A) and C9N(B) at Ashley Dene, Canterbury in autumn 2013. RGxMF is a perennial ryegrass x meadow fescue hybrid + a novel endophyte and CF is cocksfoot. All pastures were established with basal sub clover, white clover (Wc) and plantain.

Pasture	Sub clover		Wc	Plantain	Balansa	RG x TF	CF
	'Rosabrook'	'Denmark'				hybrid 'Ultra Enhanced'	
CF/Sub	5	5	0.5	0.5	0	0	2
CF/SB	5	5	0.5	0.5	4	0	2
RF*/Sub	5	5	0.5	0.5	0	10	0
RF*/SB	5	5	0.5	0.5	4	10	0

* ~20kg/ha (target) SFR31-033 AR1 perennial ryegrass broadcast on 16 April 2015 due to failure of RF to survive.

The sub clover mixture aims to compare the standard, **late flowering** 'Denmark' with the recently released more erect, **late flowering**, red-legged earth mite tolerant 'Rosabrook'.

Results

The first year was predominantly aimed at generating a seedbank for annual clover re-generation for the next 3-4 years. The first set of LWt production from ewes and lambs grazing in spring occurred in 2014/15 (Yr 2).

2015/16 (Yr 3)

- Grazing for the 2014/15 season was initiated on 20 Aug 2015 for the ryegrass based pastures (spelled over winter as ryegrass had to be oversown in autumn of Yr 2 as originally sown RG had failed to survive drought).
- For the cocksfoot based pastures grazing was initiated on 10 Sept 2015 (21 days later) because there was less feed available. This was a consequence of winter grazing (June/July 2015) to open the canopy for young sub clover seedlings which were being suppressed by vigorous cocksfoot growth.
- Net result was early grazing in ryegrass plots reflected 126 days regrowth (April-August) compared with the cocksfoot where grazing was initiated on 10 Sept on approx. 68 days of regrowth.

2016/17

- Grazing for the initial set stocking period of the spring lactation phase was initiated from 6-13 Sept as stock became available from the commercial flock. Animals assigned to each treatment were mobbed up and began rotationally grazing in late September.

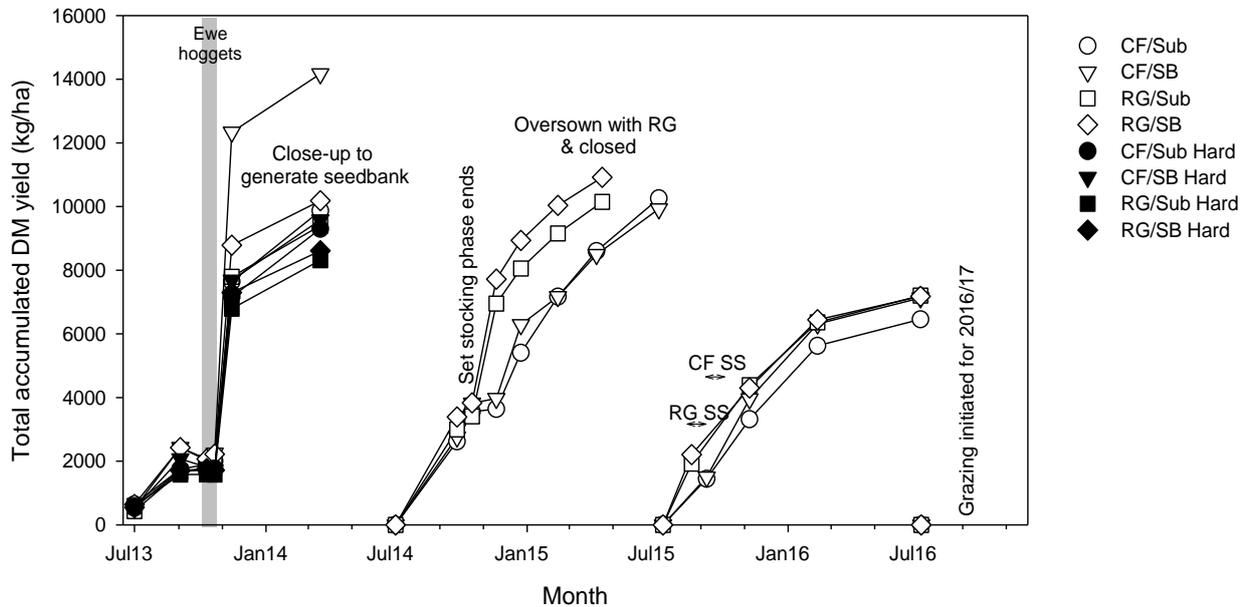


Figure 30: Accumulated DM yield (kg/ha) in 2013/14 (Yr 1), 2014/15 (Yr 2) and 2015/16 (Yr 3) of cocksfoot (CF) or ryegrass/fescue hybrid (RF) pastures established with sub (Sub) or sub and balansa (SB) clovers. White clover and plantain were included in all pasture mixes. For 2014/15 spring data is from cage cuts under set stocking. RF pastures were broadcast with approx. 20 kg/ha of AR1 perennial ryegrass in April 2015 and closed to allow establishment.

Spring 2014/15: Lactation phase summary

Total LWt production during the lactation phase was 545 ± 43.6 kg/ha of which 428 ± 29.9 was from lambs at foot. Stocking rates were similar on all pastures at 11.9 ± 0.3 ewes/ha plus 21.6 ± 1.2 lambs/ha. This resulted in a similar amount of grazing days achieved on all four pastures. Average LWt gains per head were 173 g/hd/day for ewes and 345 g/hd/day for lambs at foot during the 83 day period between 2/9/2014 and weaning on 24/11/2014.

Total stocking rates in all pastures were reduced prior to weaning (22 Oct 2014) as water stress compromised DM production (Figure 31).

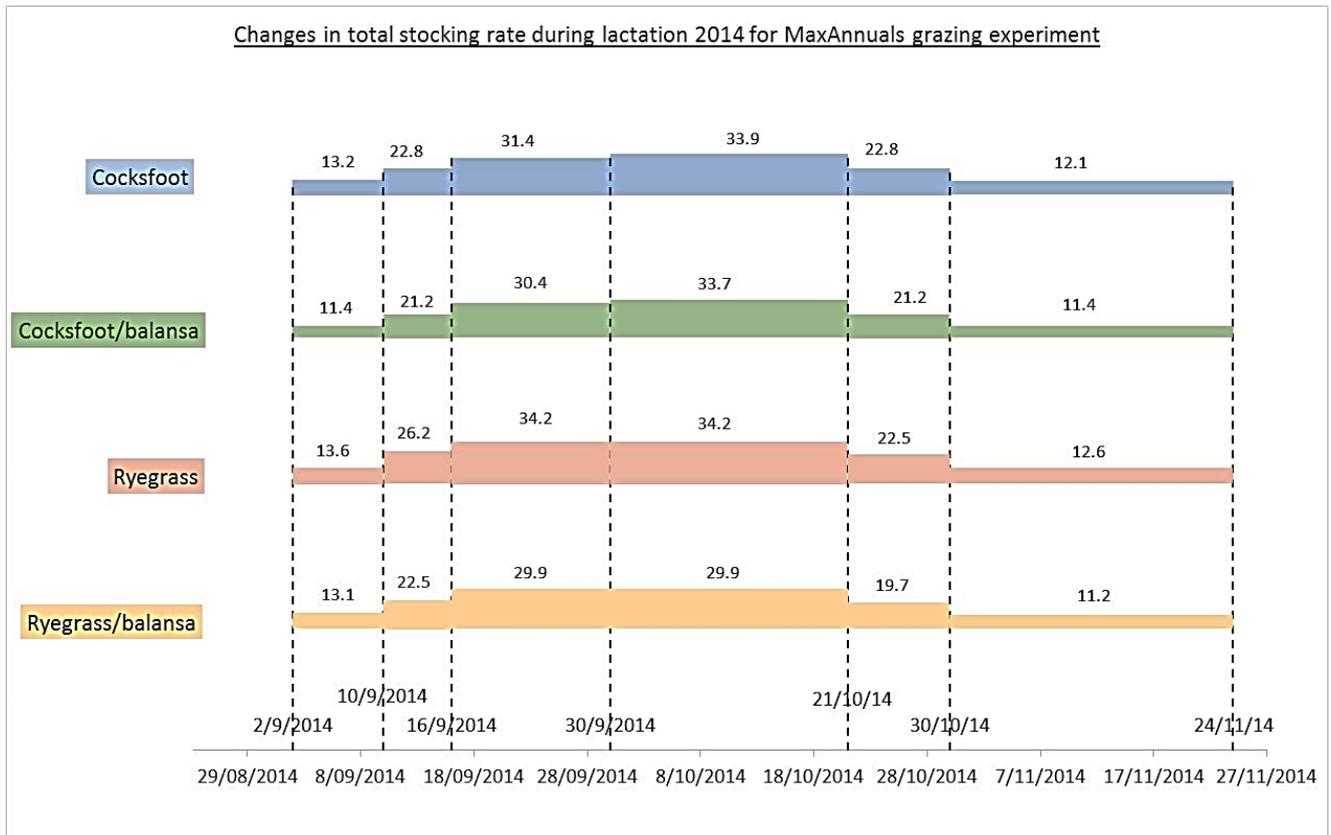


Figure 31: Changes in total stocking rate (ewes plus lambs at foot/ha) during the lactation phase on the grass/clover pastures in 2014/15.

Table 5: Stocking rate, grazing days (GD), mean daily Liveweight (LWt) gain per head, and total LWt produced/ha from ewes with twin lambs at foot set stocked on cocksfoot (CF) or hybrid ryegrass (HRG) pastures established with sub clover with or without balansa clover between 2/9/2014 and weaning on 24/11/2014.

	CF/Sub	CF/Sub/Bal	HRG/Sub	HRG/Sub/Bal
Ewe GD/ha	658	673	690	653
Lamb GD/ha	1202	1277	1299	1200
Ewe LWt gain/hd	121	158	201	212
Lamb LWt gain/hd	340	328	356	354
Ewe LWt/ha	80	109	140	140
Lamb LWt/ha	408	418	464	423
Total Lactation LWt/ha	487	527	603	563

Summer/Autumn 2014/15:

Only maintenance grazing events occurred after weaning (nil LWt gain) until June 2015 when ram hoggets rotationally grazed CF based pastures. An additional 63 kg LWt/ha was produced at this time.

Spring 2015/16: Lactation phase

- Mean daily LWt gain (g/hd/day) from lactating ewes and twin lambs at foot are shown in Table 8. Pastures were then destocked due to a lack of feed.

Table 6: Mean daily LWt gain (g/hd/day) from lactating ewes and twin lambs at foot between 20/8/2015 and 10/11/2015 (82 days)

Pasture	Class	
	Ewe	Lamb
CF/Sub	23	330
CF/SB	30	334
RG/Sub	142	317
RG/SB	115	326

- Weaned lambs were returned to the plots to graze between 6/1/2016 and 7/3/2016. During this time only two mobs grazed rotationally in an 8-paddock rotation. One mob grazed the cocksfoot based pastures (CF/Sub and CF/SB) and a second mob rotationally grazed the ryegrass-based pastures (RG/Sub and RG/SB). This was because there was no annual clover present.
- Weaned lambs gained 199 g/hd/d on cocksfoot-based pastures while those on ryegrass-based pastures grew 247 g/hd/d over the same period.
- There was insufficient feed to support autumn grazing by hoggets due to prolonged water stress conditions but a cleanup graze was performed by ewes from 7/4/2016 to 26/4/2016. This was a maintenance grazing event and LWt was not measured.

Spring 2016/17: Lactation phase

- Replicates 3 and 4 (Bethells Rd end) were stocked at 7 ewes + twin lambs at foot/ha on 6 Sept 2016. Replicates 1 and 2 were stocked at 7.5 ewes + twin lambs at foot per hectare on 13 Sept 2016.
- The delay to the start of grazing was because of late lambing in the commercial flock which limited access to stock rather than a difference in growth of the pastures.

The Solution: Annual clover based pasture systems produced high quality feed that enabled lamb growth rates of 300+ g/hd/d in early spring.

Sub clover is not “Part of the native.” It has to be actively managed.

Mr Dick Lucas and Prof Derrick Moot

The Problem – the sub clover seed bank is empty at Ashley Dene (Figure 32).

We have monitored the seed bank and seedling strike since establishment:

April 2013	10 kg/ha sub clover seed sown.
Nov 2013	Pastures spelled from October created 600 kg seed/ha.
Autumn 2014	Good establishment with March/April rains. 240 kg seed/ha remained dormant in soil.
Spring 2014	Extremely dry spring, ewes with twin lambs selectively grazed sub clover. Lambs weaned early. Little seed produce. Total seed bank 250 kg/ha.
Autumn 2015	Germination April, 100 kg seed/ha remaining in seed bank
Spring 2015	Dry spring, ewes and twin lambs graze clovers close, early weaning. Negligible seed set. Seed bank 110 kg/ha going into summer.
January 2016	Over 100 mm rain 3 January. Big flush of sub clover seedlings but all dead by early March. Seed bank now 40 kg/ha.
March 2016	Second germination after first false strike. All March germinated seedlings dead by early June. Seed bank now 16 kg/ha after second false strike.
June 2016	Third sub clover seed germination, slow growth and development of new seedlings in cold conditions.
September 2016	Only 10 small sub plants/m ² . Seed bank ~5 kg/ha.

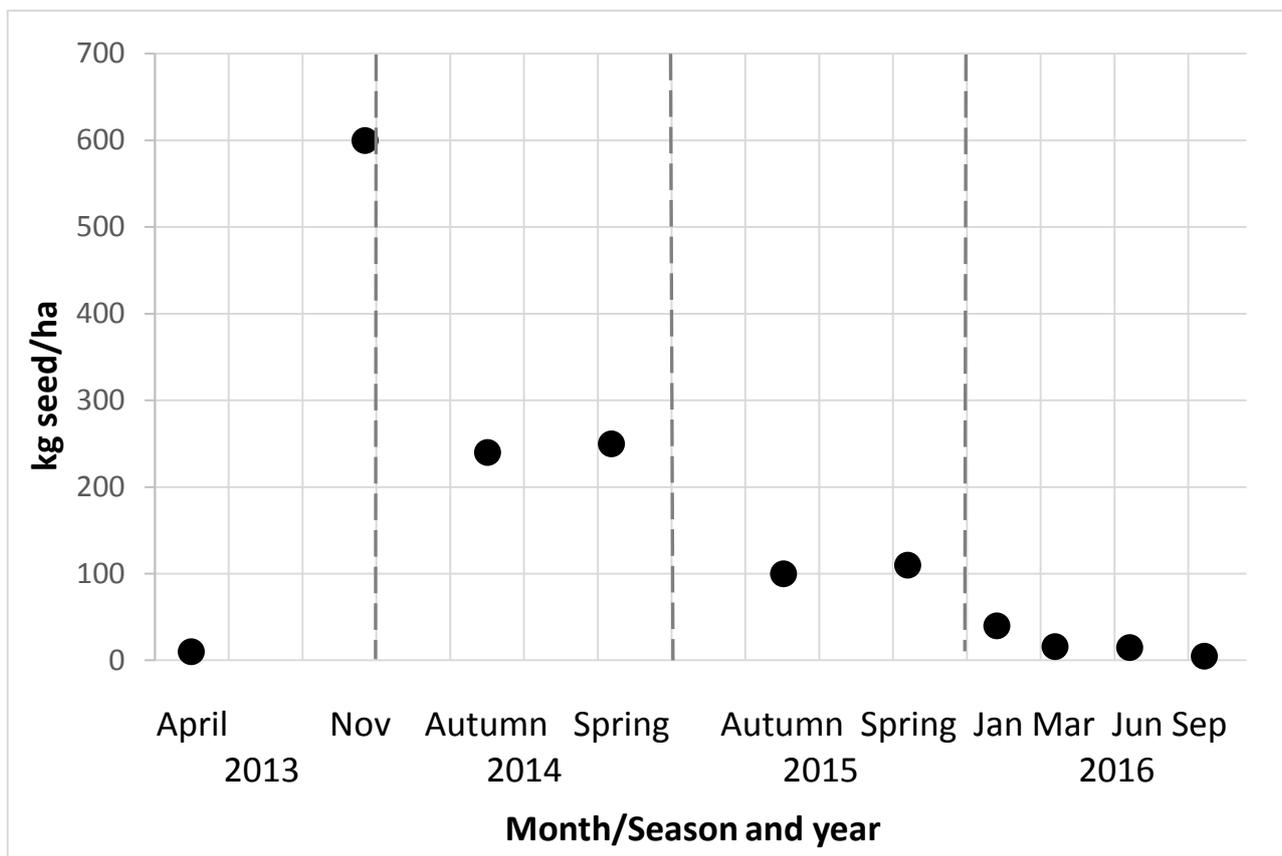


Figure 32: Quantity of subterranean clover seed in the seedbank of the MaxAnnuals pastures over time.

- Low clover in its fourth spring caused by two drier than average years and two false strikes in 2016 summer/autumn.
- Seedbank reduced from 600 kg/ha produced from early closing in the first spring (2013) to ~5 kg dormant/hard seeds in the soil.
- The low (10 sub clover plants/m²) current population is from seeds that germinated in June 2016 after two seasonal false strikes.
- They had a cold start and will struggle to produce seed under the present high grazing pressure.
- The lack of clover in all four pastures will result in lamb live weight gains less than our target of 300+ g/head/day.
- There is insufficient seed to manage the pasture to rebuild the seed bank.
- This very stony silt loam soil has very low soil moisture storage capacity and in a 600 mm rainfall it is equivalent to many sunny faces in hill country.

- The 'Denmark' and 'Rosabrook' sown are late flowering and have not set seed before running out of water in the last two years.
- The clover will have produced at least 200 kg N/ha to be used by the grass making it have a higher water use efficiency and improving grazing preference.

The Solution

- Overdrill 10 kg/ha of seed in pastures in early March 2017.
- Select mid flowering cultivars that start in the second half of September so burrs are physiologically mature by the end of October.
- These cultivars may be more suited to this difficult site.
- These newly sown subs will need lenient grazing in spring 2017 so they can create a new seed bank – it is a new sowing.

Note: On deeper soils on Iversen Field (Lincoln University campus) with greater soil moisture storage but the same rainfall as Ashley Dene the late flowering 'Denmark' sub dominated 'Campeda', a mid-flowering cultivar. But on the same soil as MAXannuals, 'Campeda' dominated 'Leura' (very late flowering). Selection of an appropriate sub for different areas can be guided by our "Sub clover management guide."

Guide for subterranean clover identification and use in New Zealand (First Edition)

Carmen Teixeira, Sonya Olykan, Dick Lucas and Derrick Moot.

Subterranean clover:

- ♣ the best adapted clover for dryland pastures in New Zealand,
- ♣ winter annual clover provides more high quality biomass during late winter and early to mid-spring than the more frequently sown perennial white clover (Figure 33), and
- ♣ particularly advantageous for high demand livestock such as lactating ewes.

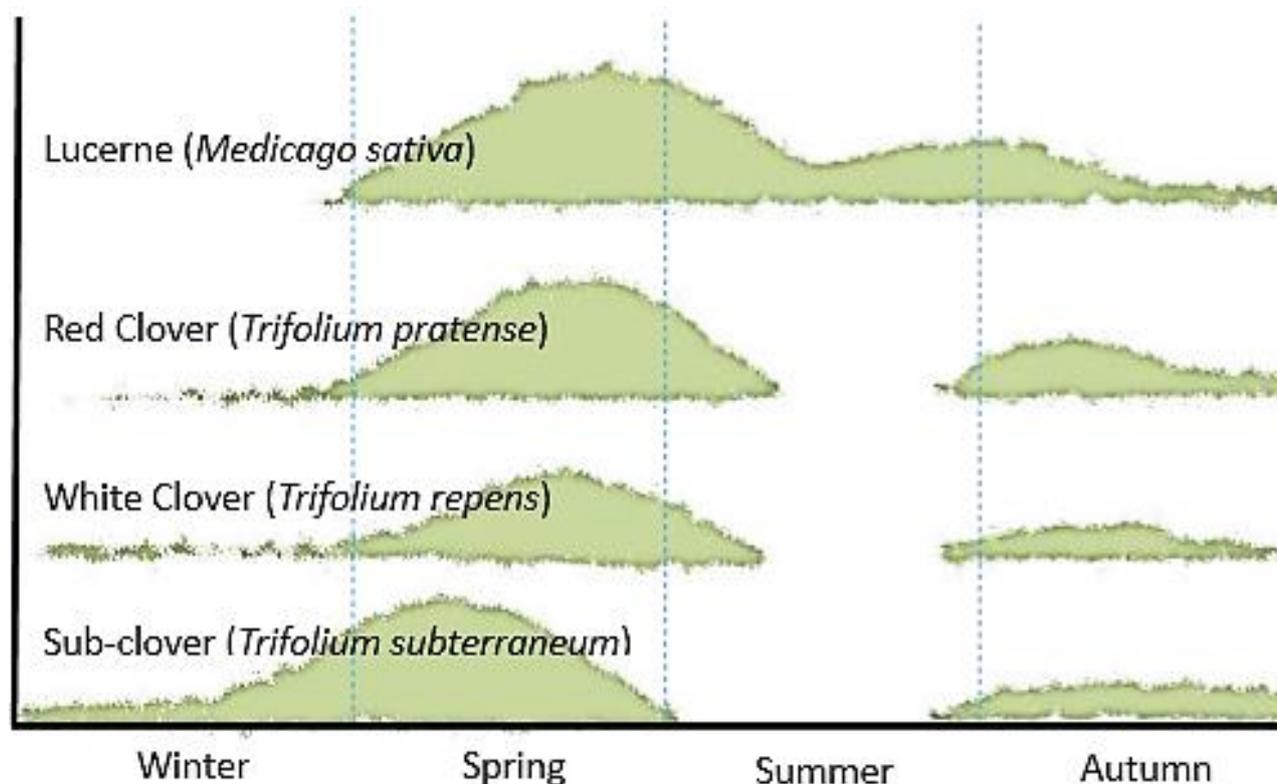


Figure 33: Seasonal biomass production of common pasture legumes under dryland conditions (adapted by Lucas, R. 2016 from Undersander et al. 2002 and Mills et al. 2014)

Features which differ between cultivars are trifoliate leaf markings, hairiness of runners (stems), petioles (leaf stems), and peduncles (flower stems), stipule colour (structure at base of petiole), and flower colour (calyx pigmentation), for example:

Mt Barker

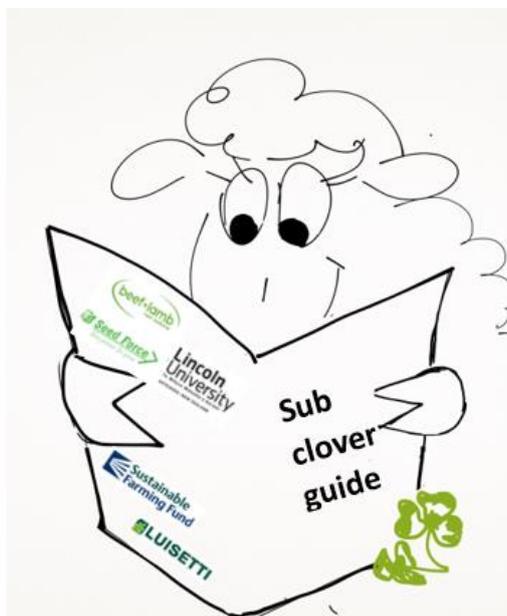


If you would like a copy of the guide:

♣ there are copies available to take away today from the Field Day or

♣ the sub clover guide can be downloaded from:

<http://www.lincoln.ac.nz/Research/Current-Research/Dryland-Pastures-Research/Research-Projects/Sub-4-Spring/>



Herbicide Options for Subterranean Clover

Teresa Lewis; Professor Derrick Moot; Ass. Prof Rainer Hoffmann

Sub clover:

- Annual legume – fixes nitrogen
- Active growth occurs winter – late spring
- Sets seed and dies over summer, avoiding drought stress

Problem: Autumn sowing of sub clover means it is highly susceptible to competition from weeds during establishment each year.

Question: Do we have viable chemical options which can effectively control weeds early in the growing season, and increase the annual yield potential?

- Only one herbicide is recommended for use on sub clover in NZ - Headstart®

This Experiment:

Eight herbicide treatments applied to four commercially available sub clover cultivars, and a white clover control.

Sub clovers: 'Antas', 'Denmark', 'Monti' and 'Narrikup'.

White clover: 'Huia II'

- Drilled 22 March 2016, but emergence delayed by no rainfall!
- Experiment 1 sprayed 14 June 2016, at 1-2 trifoliate leaf stage
- Experiment 2 sprayed 12 July 2016 at 3-4 trifoliate leaf stage

Table 7: Brand name of herbicide, active ingredient, mode of action, and product application rate

Herbicide	Active Ingredient	Mode of Action	Rate / ha
2,4-DB	400 g/L 2,4-DB	Auxin-type action	8 L
Basagran	480 g/L Bentazone	Photosynthesis inhibition	3 L
Headstart	Flumetsulam	ALS inhibition	1.0 L
Jaguar	250 g/L Bromoxynil + 25 g/L Diflufenican	Photosynthesis inhibition	1.0 L
MCPB	385 g/L MCPB	Auxin-type action	7.5 L
Pulsar	200 g/L MCPB + 200 g/L Bentazone	Auxin-type action + Photosynthesis inhibition	6 L
RoundUp	360 g/L Glyphosate	Amino Acid biosynthesis inhibition	1.0 L
Spinnaker	240 g/L Imazethapyr	ALS inhibition	400 ml



Figure 34: Plant growth at application date. Top is Experiment 1, sprayed 14 June 2016; Bottom is Experiment 2, sprayed 12 July 2016.

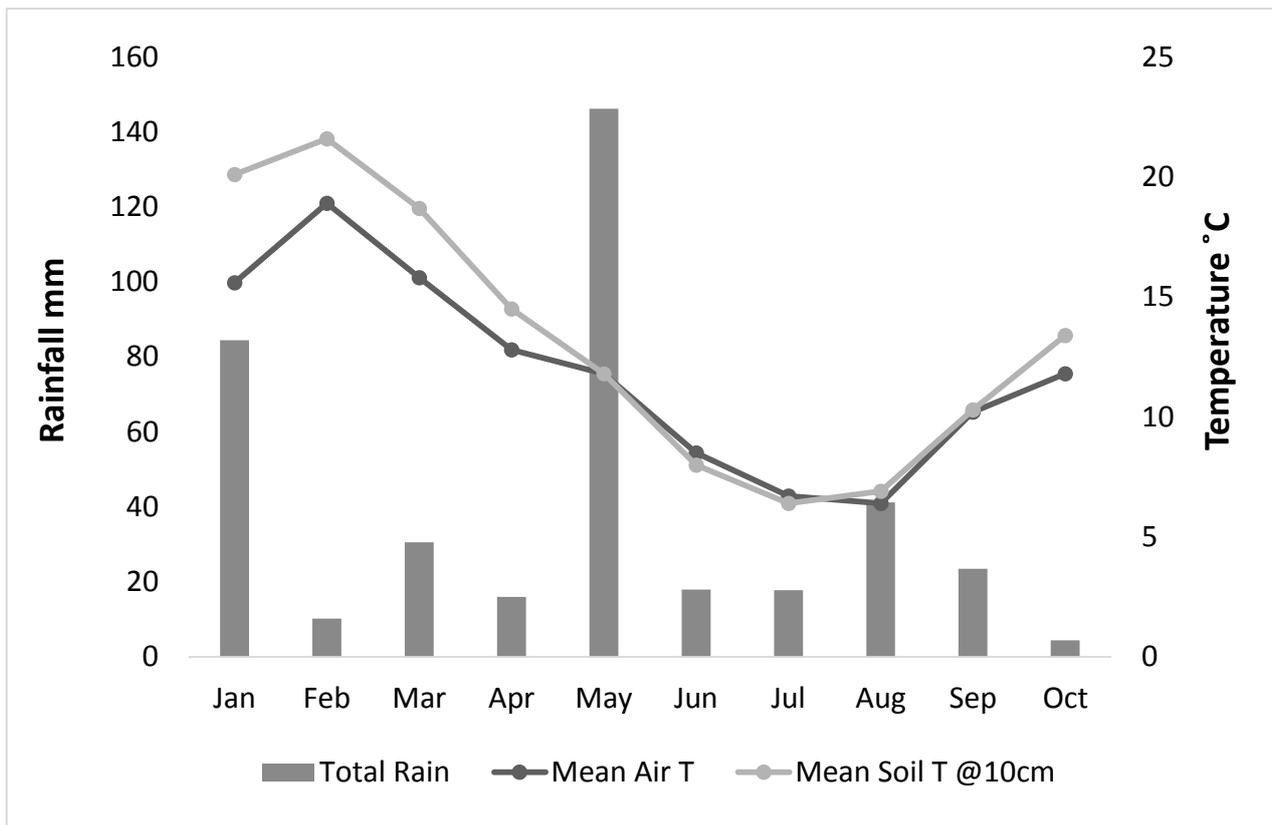


Figure 35: Average weather data for Ashley Dene, Springston from January 2016.

Preliminary results:

Harvest yields from the 1-2 trifoliolate leaf stage spraying

- Herbicides have different effects on cultivars
- ‘Antas’ was highly susceptible in terms of percentage yield decrease, but still had higher yields than ‘Monti’ and ‘Denmark’ in all treatments.
- ‘Narrikup’ was the most tolerant, and maintained high yields.
- ‘Monti’ hasn’t thrived in this dry, well-drained environment, but was tolerant of herbicide.
- ‘Denmark’ was very tolerant, but low yielding. Would be a good companion cultivar.
- EWRS scores can provide a relative estimate of damage, but needs support from harvest yields.
- This spring the sheep preferentially grazed plots with successful weed control, as easier access to clover.

Note yield advantage to Antas and Narrikup over white clover.

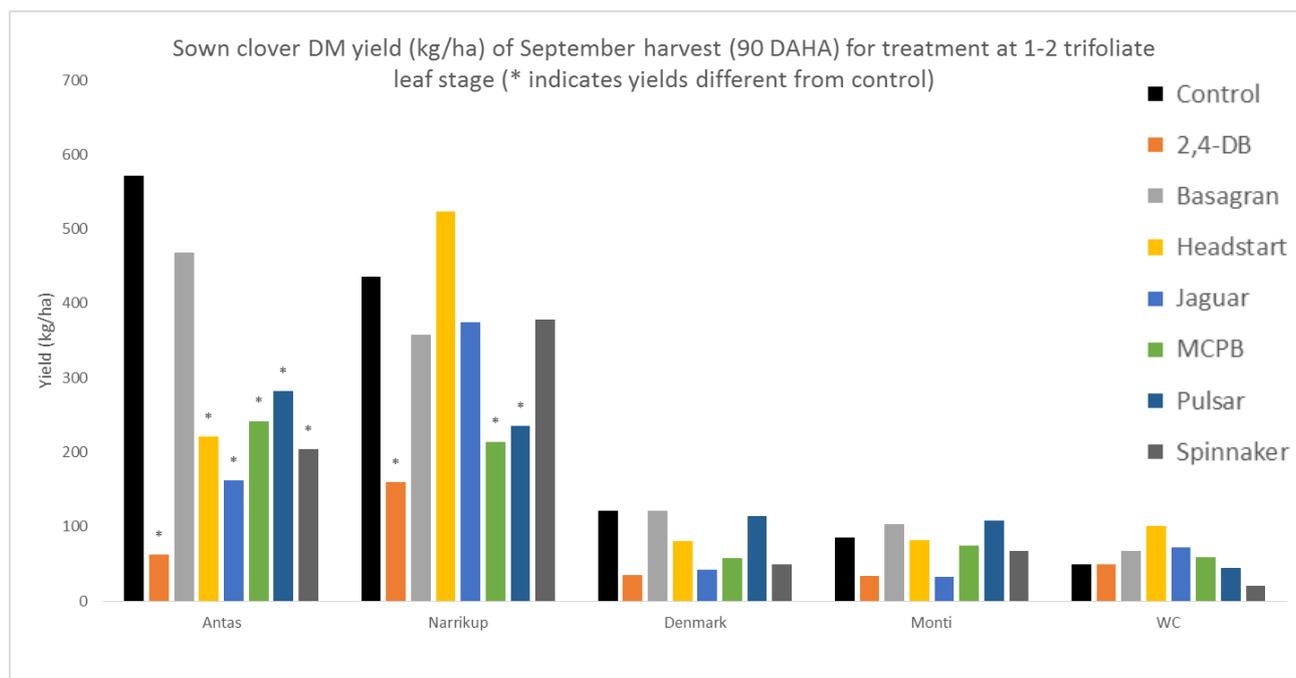


Figure 36: Sub clover DM yields (kg/ha) at 90 DAHA with treatment applied at the 1-2 trifoliolate leaf stage.

Table 8: Sown sub clover yields (kg/ha) from September harvest of 1-2 (90 DAHA, harvested 16/09/16) and 4+ (60 DAHA, harvested 20/09/16) leaf stage treatment applications. (*indicates different from control P<0.001)

Leaf stage	Antas		Denmark		Monti		Narrikup		WC	
	1-2	4+	1-2	4+	1-2	4+	1-2	4+	1-2	4+
Control	570	330	120	160	85	105	435	700	50	15
2,4-DB	60*	200	35	25	30	10	160*	120*	50	15
Basagran	470	330	120	205	105	120	360	575	70	10
Headstart	220*	210	80	50	80	65	525	290*	100	20
Jaguar	160*	70*	40	50	35	50	375	190*	75	15
MCPB	240*	130*	60	40	75	35	215	280*	60	20
Pulsar	280*	170*	115	55	110	35	235*	345*	45	25
RoundUp	0*	0*	0	0	0	0	0	0*	0	0
Spinnaker	205*	170*	50	45	70	50	380	400*	20	45

Solution:

- Basagran® and Headstart® have provided effective weed control with minimal impact on sub clover.
- Time of application hasn't affected clover DM yields relative to controls for Basagran®, Headstart® and Spinnaker® treatments.
- Successful weed control lead to heavier grazing of treated plots.

Student projects on Pastoral 21/SFF

Natalie Stocker	BAGSci (Hons)	completed 2011
Alice Speedy	BAGSci (Hons)	completed 2012
Sarah Bennett	BAGSci (Hons)	completed 2012
Mart-Marie Roux	BAGSci (Hons)	completed 2012
Emma Coutts	BAGSci (Hons)	completed 2013
Richard Sim	PhD	completed 2014
Lisa Box	BAGSci (Hons)	completed 2014
Russell Croy	MAGSci	In progress
Teresa Lewis	MSc	In Progress
Carmen Teixeira	PhD	In Progress

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Ministry for Primary Industries
Manatū Ahu Matua

