“Focus on Sub” Field Day

Thursday, 23rd November 2017

At Koromiko Farm, the property of Lucy and Hugh Dampier-Crossley

Speakers: Professor Derrick Moot and Mr Dick Lucas, Lincoln University

Farmers: Hugh Dampier-Crossley, Chris Crossley and Hamish Craw.

Dryland Pastures Research and ‘Sub 4 Spring’

‘Sub 4 Spring’ research was undertaken as part of Project 408090 funded by Ministry for Primary Industries Sustainable Farming Fund, Beef + Lamb NZ, Luisetti Seeds and Seed Force.

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 Solution: Which legume drives your system?

- 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 gain (LWG/ha) but enable the high quality forages to survive and thrive.
- Persistent grass species that respond to moisture during summer dry periods (Cocksfoot).
- Appropriate research information to allow farmers to develop management systems that maximize the benefits of dryland pasture species (Field days)!

Field Day Programme

Time	Speaker and topic
12 pm	*Koromiko Farm woolshed* *BYO Lunch, tea and coffee provided*
12.30 pm	Derrick Moot (Lincoln University): Introduction to Dryland Pastures Research Team, Ashley Dene Farm and MaxAnnual research (pg 1-7) Hugh Dampier-Crossley (Farm owner): Health and Safety Hannah Eastgate (ECan): Chilean needle grass
1.00 pm	*Stop 1: Leamington Face, Koromiko*
1.20 pm	Derrick Moot: Introduction to Sub 4 Spring Hugh Dampier-Crossley: Increasing sub clover through management Dick Lucas (Lincoln University): Identifying the resident sub clover and life cycle Derrick Moot: Sub clover grazing management
2.00 pm	*Stop 2: Move to experimental area, park on the flat* *Walk up the track – South slope*
2.20 pm	Dick Lucas: Botanical composition of the hill country pasture Hamish Craw (Banks Peninsula farmer): Banks Peninsula sub clover Dick Lucas: Role of herbicide sprays
2.50 pm	*Walk around track – North East slope*
	Derrick Moot and Hugh Dampier Crossley: Preparing for this year Derrick Moot: Port Hills recovery Dick Lucas: Mt Benger
3.45 pm	*Optional refreshments in the woolshed and a chance for one-on-one discussions with the speakers*

Ashley Dene – MaxAnnuals

Dr Alistair Black, Mr Dick Lucas and Prof Derrick Moot

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

A) 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 (Figure 1). Two replicates 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 from 2014-2017.
- On 10 Oct Reps 2 and 4 were closed. Reps 1 and 3 were closed on 18 Oct 2013.

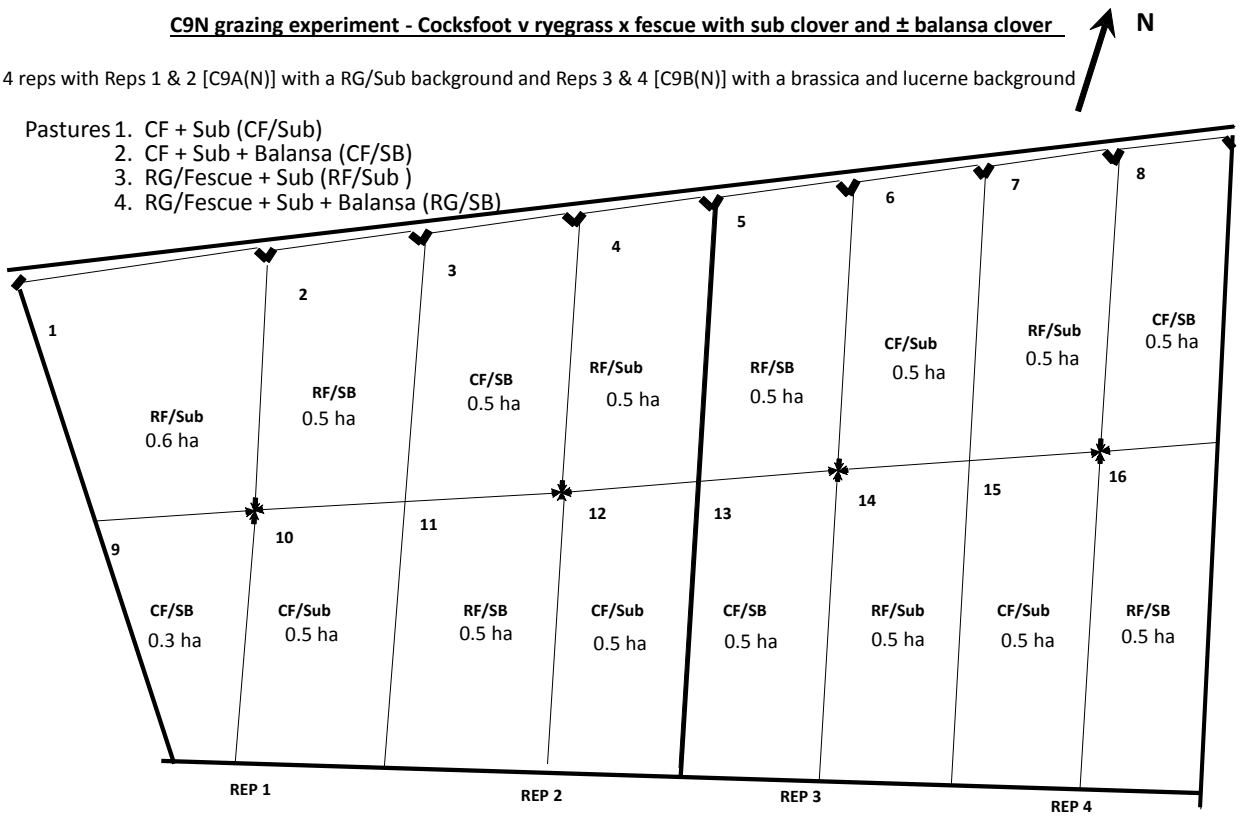


Figure 1: Experimental plan of the MaxAnnuals clover based pastures in C9A&B(N) at Ashley Dene, Canterbury.

Table 1: 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.

	Sub clover		Wc	Plantain	Balansa	RG x TF hybrid 'Ultra	CF
Pasture	'Rosabrook'	'Denmark'	'Nomad'	'Tonic'	'Bolta'	Enhanced'	'Greenly'
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

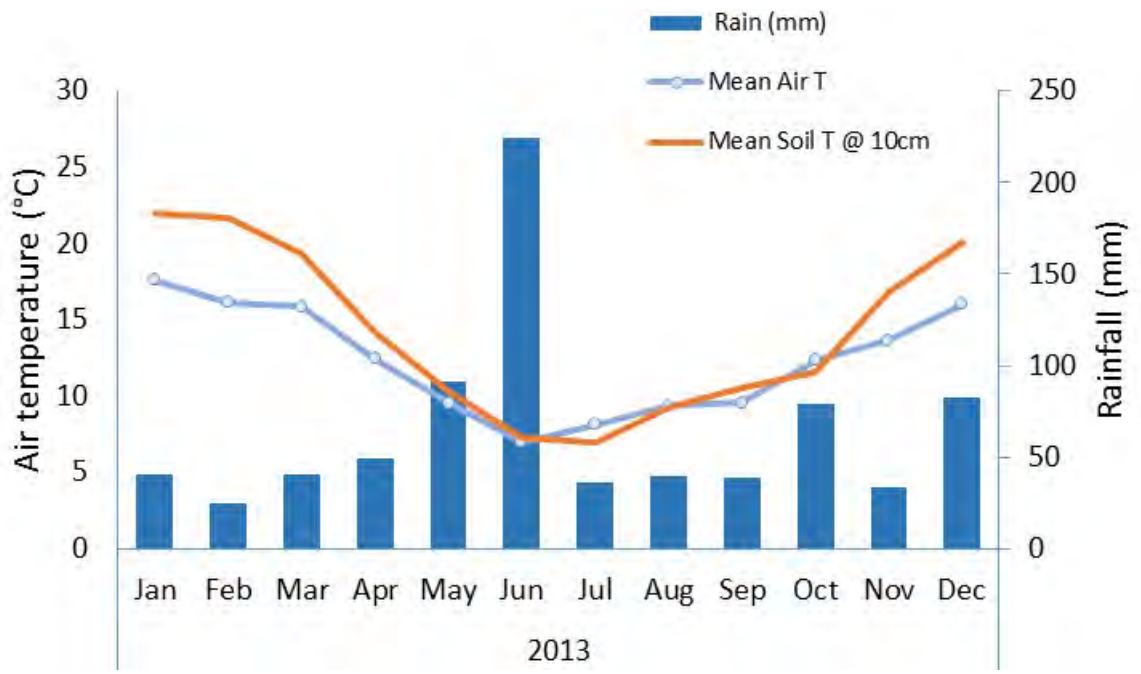
* ~20kg/ha (target) SFR31-033 AR1 perennial ryegrass broadcast on 16 April 2015 due to failure of RF to survive.

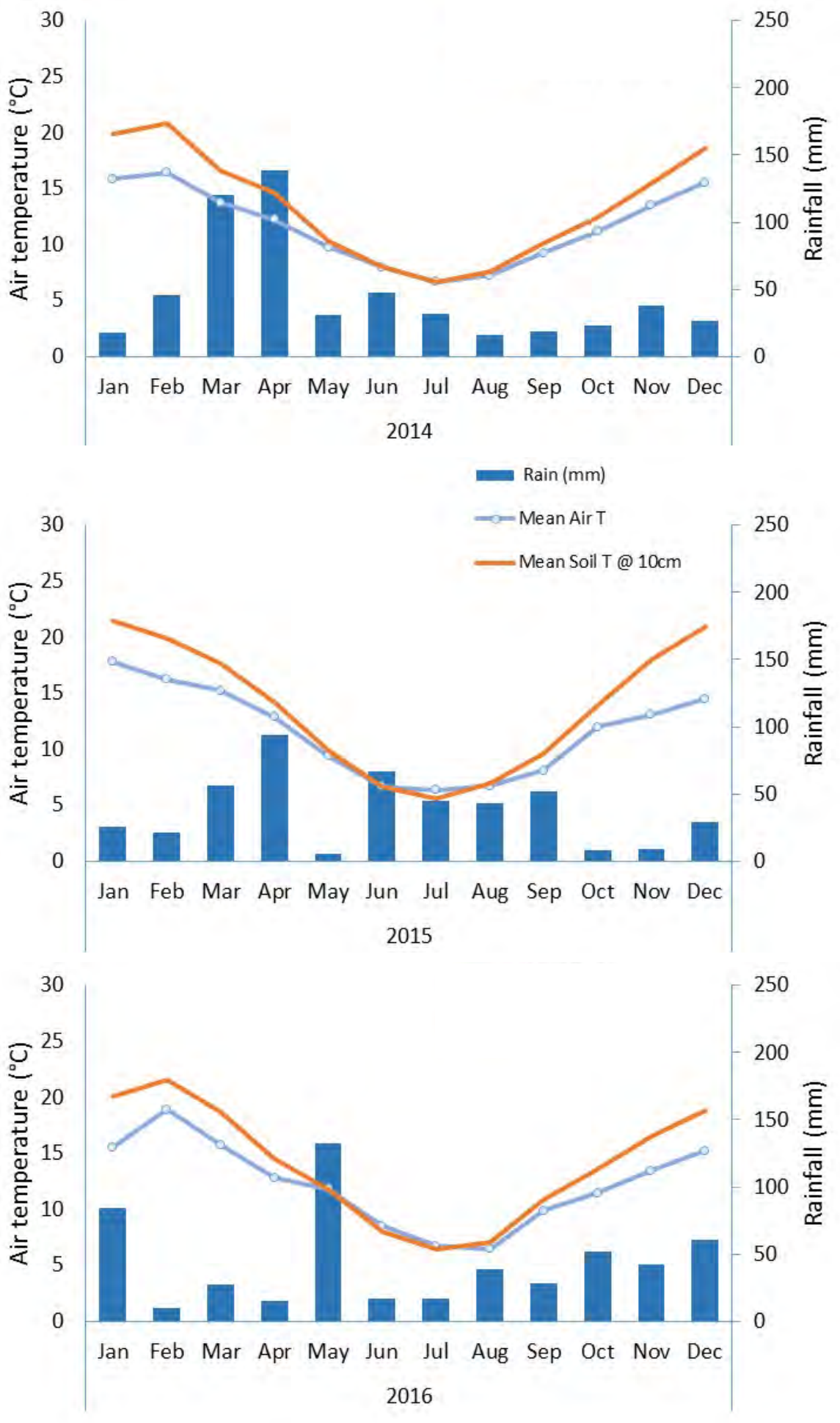
The sub clover mixture aims to compare the standard, **late flowering** 'Denmark' with the recently released more erect, **late flowering**, red-legged earth mite tolerant 'Rosabrook'.

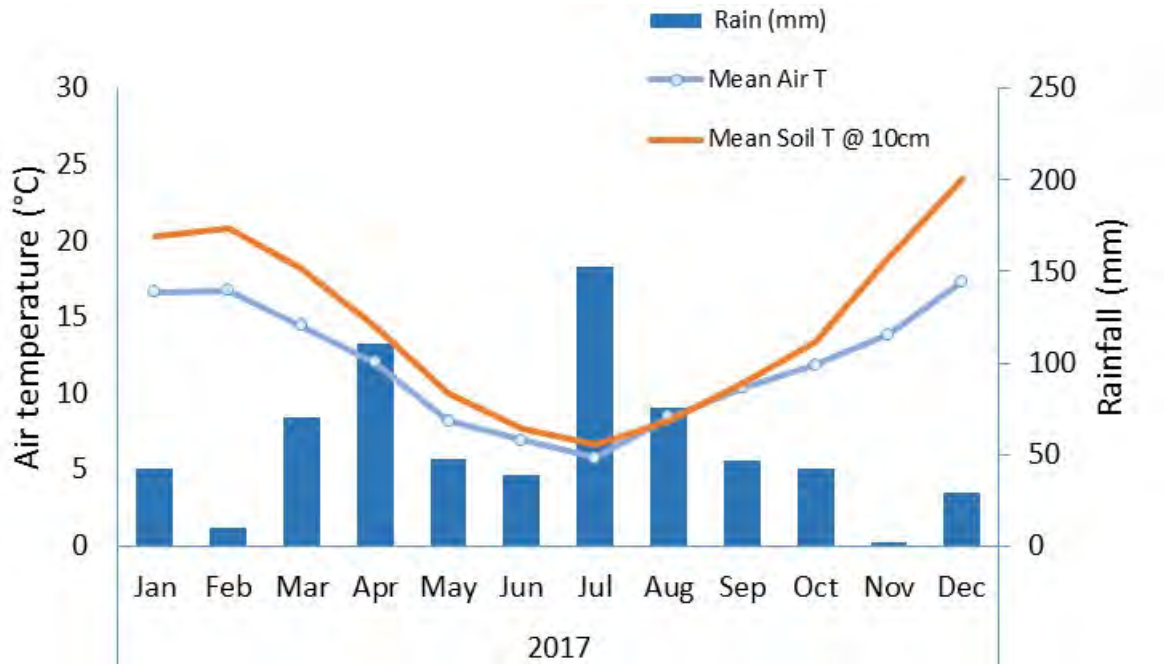
RESULTS

Climate data for Ashley Dene 2013-2017

The following five graphs describe rainfall, mean air temperature and mean soil temperature at Ashley Dene for the last five years. (Graphs produced by Keith Pollock, Lincoln University).




Air temperature (°C)
Rainfall (mm)
Rain (mm)
Mean Air T
Mean Soil T @ 10cm
Jan Feb Mar Apr May Jun Jul Aug Sep Oct Nov Dec
2014
2015
2016



MaxAnnuals results (years 1-4)

Total net liveweight production (kg lwt/ha)

- In Year 1 (July 2013 to June 2014), which was the wettest year, 361 ± 26.8 kg LWt/ha was produced regardless of pasture treatment (Table 2).
- In 2014/15 (Year 2), 391 ± 18.5 kg LWt/ha was produced. LWt production from the RG/Sub pasture (423 kg/ha) was superior to the 358 kg LWt/ha produced from animals assigned to the CF/Sub pasture (P<0.1). However, ryegrass plants died in this environment and, despite efforts to re-establish it, the pastures have become plantain/annual clover based pastures.

Table 2: Net total accumulated annual liveweight production (kg LWt/ha) from sheep grazing one of four dryland ryegrass or cocksfoot based pastures at Ashley Dene, Canterbury.

Pasture	2013/14 Year 1	2014/15^ Year 2	2015/16 Year 3	2016/ 2017 Year 4
CF/Sub	388	358 $_{c}$	396	492
CF/S+B	383	367 $_{bc}$	415	538
RG/Sub	352	423 $_{a}$	603	528
RG/S+B	322	412 $_{ab}$	569	485
Mean	**361**	**391**	**496**	**511**

^ Means are separated based on a treatment effect at an 0.1 level of significance in the ANOVA

- Liveweight production was unaffected by pasture type in 2015/16 (Year 3) with 496±75.7 kg LWt/ha produced. However, the 406 kg LWt/ha produced from the cocksfoot based pasture mixes was 33% less (P<0.05) than the 586 kg LWt/ha from the plantain dominant based pastures. This reflects the more open spaces for the sub clover to inhabit.
- Between July and the end of February in the 2016/17 growth season 511±22.3 kg/LWt/ha was produced. This highest average yield reflected the wet spring which maintained growth for the longest spring period on these shallow stony soils.

Seasonal weighted mean liveweight gain

To account for differences in the duration of individual LWt periods a weighted seasonal LWG was calculated for each stock class grazing the pastures. Data for the ewes and lambs in spring are presented in Figure 2.

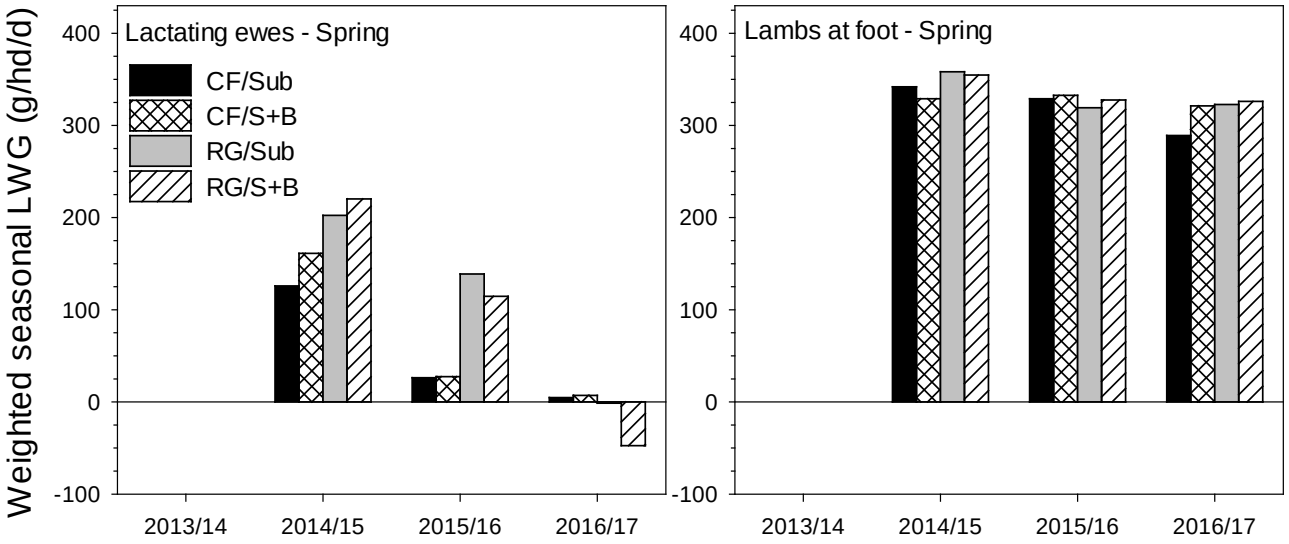


Figure 2: Weighted seasonal liveweight gain (LWG g/hd/d) of ewes and lambs which grazed one of four annual clover based dryland pastures at different times between 2013/14 and 2016/17.

- Spring LWG of lambs at foot was consistent from the initiation of grazing to either weaning or destocking across the four annual clover based pastures and averaged 330 g/hd/d for twins between 2014/15 and 2016/17.

Live weight data for Spring 2017

The first ewes and lambs were weighed and put on to the plots on 31 August 2017, when the lambs were approximately 5 days old. The remaining plots were stocked as the animals became available until the plots were fully stocked by 13 September.

Plots were set stocked at 14.5 ewes per hectare, with each ewe rearing twin lambs. This stocking rate was higher than the 10 to 11 ewes per hectare in previous years,

because the quantity and quality of feed on offer was higher. The higher than usual quantity of feed on offer was the result of a combination of lambing 2 weeks later than normal and having an early spring. The improved quality of the pastures was entirely due to the excellent sub clover seedling survival in autumn and the regular rains received subsequently (Plate 1).

The live weight gains of the sheep in early spring have been pleasing (see Table 3) with one treatment group of lambs growing at 391 g/head/day for one fortnightly period in late October, but overall they were compromised by a period of wet cold weather in early October.

With the recent lack of rain, higher temperatures and drying winds, the stocking rate on the grazing treatments was halved in the first week of November and have now (17/11/17) been destocked.

Table 3: Mean daily live weight gain (g/hd/day) from lactating ewes with twin lambs at foot between 31/8/2017 and 6/11/2017 (67 days).

	Stock Class	
Pasture	**Ewe**	**Lamb**
CF/Sub	71	301
CF/SB	56	316
RG/Sub	85	337
RG/SB	70	334

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

Plate 1: Early season RG/SB (left) and CF/Sub (right) pastures showing the excellent clover content. (Photos taken by Malcolm Smith on 11th October 2017).

Stop 1: Leamington Face, Koromiko

Hugh Dampier-Crossley

Fertiliser history

Soils not tested but pH should be about 5.7, Olsen P 17-22, and Sulphate-S about 6.

Last autumn this paddock got 140 kg Sulphur Super 30 + Mo/ha as did the rest of the developed country as it had missed a year due to the drought.

Usually it would get 100-130 kg Sulphur Super 20/ha annually.

Grazing management

- It is not set stocked for lambing due to it being an access lane for stock.
- It is lightly grazed through to mid-November, as has been done this year, and then shut up until about the 10th of December.
- Then it is used as a holding paddock for big mobs of ewes and lambs for the time around weaning. By this time a lot of the sub has had time to set seed.
- During the summer it is again used as a holding paddock for big mobs of ewes during crutching in January and shearing in late February and it gets grazed down really hard.
- After shearing it is usually spelled which is when the sub is striking if it has rained.

I have not introduced any sub seed to this block since I have been here and have noticed this year that a lot of the sub there is not Mt Barker. [There is also Tallarook and Woogenellup in this paddock – DL].

I have noticed the sub content increase over the last few years and have put it down to the way it is grazed.

Plate 2: The dark green patches on these Koromiko hill slopes on 13/10/17 were established sub clover. A good growing season and careful grazing management have allowed this annual legume to thrive. (Photo: Sonya Olykan).

Managing resident sub clover and introducing new sub clover

Dick Lucas and Derrick Moot

Is resident sub clover present?

- The best time to assess sub clover presence is by walking across your paddocks in September/October.
- If you step on a sub clover plant/patch every second step, about every 2 metres, then that is acceptable.
- Given the opportunity, the sub clover runners will extend the patch up to 60 cm in diameter in a season with spelling.

Plate 3: 'Mt Barker' sub clover in late autumn/winter with a 10 x 10 cm scale. Note significant pigmentation of the leaves and prostrate rosette growth form in the cool season. Once runners start elongating in spring new leaves have no brown pigmentation.

There are a number of ways to manage and improve the sub clover content of existing pastures. Calendars for the following are described:

1. Acceptable resident sub clover - manage to increase sub content
2. Low or no resident sub clover - plan to oversow the following autumn
3. Drilling sub clover into existing pasture

1. Acceptable resident sub clover - manage to increase sub content

Use the following timeline to manage grazing to increase sub clover content:

When	Task/Comment
September	**Paddock walk to identify sub clover populations** Greater than 1 sub clover plant/patch every 2 m Normal stocking rates, keep grazing above 1200 kg DM/ha
Mid-September onwards	**Identify when sub clover flowers are obvious** This will depend on the sub clover cultivar (check the sub clover guide. NB: sub clover flowers are small - see Plate 4). Spell the paddock for four to five weeks or longer if possible (e.g. up to 8 weeks)
After spelling	**Graze with cattle after spelling** This will limit amount of grass seed produced. Sheep target sub clover runners and eat the seeds.
Summer grazing	**Graze with stock as required depending on rainfall** Reduce pasture mass to 700 kg DM/ha by the end of February
End of February until significant autumn rain (over 200 mm)	**Remove any tag** Keep grazing pasture down to 700 kg DM/ha. Opening up the pasture will aid sub clover seed germination.
Autumn	**Monitor rainfall and watch for sub clover germination** Sub clover germination triggered by a rainfall > 20 mm. **Spell to allow sub clover establishment** Spell the paddock to allow established sub clover plants to reach 3-4 trifoliate leaf stage (see Plate 5). The graze preferably with cattle to remove grass.
Winter	**Graze as required** Keep pasture above 1200 kg DM/ha. If possible spell lambing paddocks to build clover rich pasture for lambing. A sub clover rich pasture is great feed for lactating ewes

- ♣ Manage at least one paddock/block each year on a sub clover friendly manner.

Plate 4: Sub clover flowers are small - about 10 mm long and 3-4 mm wide. Mt Barker (left) has red-banded flowers which helps with cultivar identification in the spring. Antas flowers (right) have no bands. Photos: David Hollander.

Plate 5: Earlier growth stages of the Mt Barker sub clover cultivar: cotyledons (top left), unifoliate or spade leaf (bottom left), five trifoliate leaves (right). Photos: David Hollander.

- The ultimate aim of long-term grazing management is to have 80% ground cover of sub clover in the spring pasture. This means there is 40-50% clover DM on offer.
- Spelling pastures to 'rejuvenate' sub clover populations is not required every year but is recommended that each paddock is managed to favour sub clover about once every five years – do paddock walks to monitor sub clover contents from year to year.

2. Low or no resident sub clover – plan to oversow the next autumn

Use the following timeline to improve sub clover content on uncultivatable hills by oversowing seed in autumn:

When	Task/Comment
September	**Paddock walk to identify sub clover populations** Less than 1 sub clover plant/patch every 2 m **Plan to oversow with sub clover next autumn:** ♣ Investigate sub clover cultivar options[1] ♣ Soil test – check recent results or get soils tested Check that pH is > 5.6, Olsen P is 15-19, and Sulphate-S > 8. ♣ Order sub clover seed – need 10 kg/ha
September to January	**Graze as normal** If some resident sub clover is present aim to keep pasture above 1200 kg DM/ha
February to mid-March	**Remove any tag** Chew the pasture down hard to 700 -1000 kg DM/ha. Opening up the pasture will aid resident and oversown sub clover seed germination
Mid-March	**Oversow with sub clover seed and apply fertiliser if required** **Monitor rainfall and watch for sub clover germination** Sub clover germination triggered by a rainfall > 20 mm. **Spell to allow sub clover establishment** Spell the paddock to allow sub clover seedlings to reach 3-4 trifoliate leaf stage
Winter/spring	**Graze lightly in the first year preferably with cattle** Keep pasture at about 2000 kg DM/ha to control grass so clover is not shaded Lamb on pasture
Mid-September onwards	**Identify when sub clover flowers are obvious – usually early October** Spell the paddock for at least six weeks then graze with cattle to get on top of the tall pasture. Ongoing management as previously outlined for acceptable sub clover content

[1] Look at sub clover cultivar options in the Sub clover guide or DPR blog posts.

OVERSOWING COSTS AT KOROMIKO

Hugh Dampier-Crossley

The following are the costs to oversow the uncultivatable hill country at Koromiko:

Item	Cost per hectare
Fertiliser: Sulphur Super 20 (incl. Transport)	$90
Sub clover seed (10 kg)	$100
Helicopter to apply fertiliser and seed	$25
Total:	**$215**

This is very cheap development considering the cost of the tractor and drill alone to direct drill our cultivatable country is around $130-$145/ha, with the cost of spray, helicopter, fertiliser and seed on top of that.

3. Drilling sub clover into existing pasture

At a Koromiko Field Day in May 2015, at the end of a very dry autumn, it was suggested that the North Canterbury farmers present should consider direct drilling sub clover into bare, dead and dying pastures as soon as possible. The aim being to grab the opportunity to inject some superior sub clover cultivars into depleted pasture where competition from resident grasses was likely to be minimal.

The following photos show the excellent result achieved by Chris Crossley who put the over-drilling suggestion into action on his farm 'Cranford' in Rotherham. The mix of sub clovers including Antas re-established naturally in autumn 2016 and again in 2017.

Plate 6: Strip sown sub clover on part of paddock at 'Cranford', Rotherham (13/9/17, Photo: Dick Lucas).

Plate 7: Chris Crossley *et al* standing in the strip at 'Cranford', Rotherham (13/9/17, Photo: Dick Lucas)

Plate 8: Sub clover cultivar 'Antas' leaves in strip at 'Cranford', Rotherham (13/9/17, Photo: Dick Lucas).

Use the following timeline to improve resident sub clover content by drilling sub clover into rolling hill country:

When	Task/Comment
September	**Plan to drill selected paddock(s) with sub clover next autumn:** ♣ Investigate sub clover cultivar options[2] ♣ Soil test – check recent results or get soils tested Check that pH is > 5.6, Olsen P is 15-19, and Sulphate-S > 8. ♣ Order sub clover seed – need 10 kg/ha
September to January	**Graze as normal or Herbicide if green in Oct-Nov** Graze or consider herbicide pre-drilling if green
End of February to mid-March	**Remove any tag** Chew the pasture down hard to 700 -1000 kg DM/ha Opening up the pasture will aid sub clover seed germination and establishment
February (if soil is moist) to mid-March	**Drill in sub clover seed and apply fertiliser if required** **Monitor rainfall and watch for sub clover germination** Sub clover germination triggered by a rainfall > 20 mm. **Spell to allow sub clover establishment** Spell the paddock to allow established sub clover plants to reach 3-4 trifoliate leaf stage
Winter/spring	**Graze lightly in the first year** Can lamb on the new paddock. Keep pasture above 2000 kg DM/ha and consider using lower stocking rates than normal
Mid-September onwards	**Identify when sub clover flowers are obvious** Spell the paddock for at least six weeks to maximise seed set. Ongoing management as previously outlined for acceptable sub clover content
December	**After spelling for seed set, graze with cattle**

[2] Look at sub clover cultivar options in the Sub clover guide or DPR blog posts.

Stop 2: Experimental area - Hamish & Annabel Craw, Annual Summary 2016-17

Objective

- Increase the legume content of uncultivated improved hill country to increase pasture MJ ME/ha and t DM/ha
- Trial and evaluate methods of suppressant spraying to establish a range of legumes and plantain.

Results

Summary

- Initiated second full paddock scale application of spray treatment in '100 acres - 104' paddock spray via helicopter on 19th October, 2016 with 500 ml/ha Valiant. Very still and clear conditions resulting in excellent kill of poorer quality grass species.
- Paddock rested to allow flowering and seed set of sub and white clover. Excellent flowering, abundances of sub clover leaders, white clover seed set delayed due to cooler summer conditions.

Photos supplied by: H&A Craw

- Replacement ewe lambs grazed paddock on 3rd January, 2017 (approx. 80 days later), further lambs were added 4th – 14th January. Surprisingly lambs aggressively grazed yarrow seed heads. Limited grazing of white clover flowers, indicating that earlier grazing is an option.
- Balancing act required between resting the paddocks long enough for flowering and seed set without missing opportunity to harvest pasture mass at critical time of year.

- By eliminating poorer grass species (which go to seed and lose quality from November onwards) through the spray program, the paddock was able to be rested for flowering and seed set and maintain pasture quality. Presenting greater opportunity for a range of stock classes to graze the pasture at a time of year when animal performance does not want to be sacrificed.
- Due to several late summer/early autumn rains multiple sub clover seed strikes occurred (1st March & 25th March) which became a juggling act managing seedlings at different growth stages. Introduced seed was held off until naturalised seedling could be grazed without damage occurring. Pinch test done on all new seedlings to ensure they would not get ripped out by stock during grazing.

Photos (this page) supplied by: H&A Craw

- On 21st April, 2017 weather conditions finally allowed helicopter to apply 10 kg of subterranean clover (3.3 kg Antas, 3.3 kg Woogenellup and 3.3 kg of Campeda) along with 1 kg of white clover onto the trial area. The reason for doing this is to introduce new higher producing clover varieties and fresh inoculate.
- This area was immediately grazed for seven days, with 1500 ewes using "hoof and tooth" to ensure good seed-to-soil contact and reduce some of the pasture cover that had accumulated in wake of the rain.
- 15th May first signs of seed strike occurred.

- As a way of a comparison, it was decided to sprayed another 7 hectares (Totaras) with 1.5 L Glyphosate (+ accelerate) and direct-drilled the seed into the sprayed area to see if there was any difference between aerial application of seed with direct soil contact.
- On 21st April, 2017 an aerial application of 1.5 L Glyphosate (+Accelerate)
- 30th April, 2017 direct drilled 10 kg sub clover (Antas, Woogenellup, Campeda). Stock removed prior to drilling.

Spring 2017 Photos

August 15th, 2017 – Under set stocking 6 stock units/ha twin and triplet middle band scanned ewes: (Photos supplied by: H&A Craw)

29th September, 2017 – Under set stocking 6 stock units/ha twin bearing ewes and lambs: (Photos supplied by: H&A Craw)

What were the key points?

- Spray treatment very effective at eliminating poorer grass species and allowing clovers to flourish to maintain pasture quality when resting paddocks for flowering and seed set.

- Pasture quality remains high post resting allowing flexibility as to what stock class is able to graze and maintain animal performance.
- Balancing act required with multiple seed strikes and plants at different growth stages.
- Maintaining some form of pasture cover plays an important role in creating a protective environment for new seedlings.
- Glyphosate treatment does not look as promising as Valiant treatment as it eradicated too much existing clover. Currently observing spring growth to understand pasture composition compared to Valiant treatment.
- AgResearch conducting assessment on growth rates and pasture composition during spring summer. First results will be available in October.
- There appears to be some plant losses occurring during winter, there is speculation this could be due to cold wet conditions, chemicals released by clovers or late seed application. Further discussions amongst the project group is occurring at present. Measurements by AgResearch will quantify plant counts of various species.

Going forward

What aspects of the project were difficult and what changes are required in terms of managing the project next year?

- Chemical spray companies are no longer recommending Valiant as a suitable spray to be applied to grazed pastures. Centurion an alternative spray has been recommended and will be used instead of Valiant for future applications. Throughout this project a long resting time (80 days) has used between Valiant application and grazing and a capital stock class has been used for the first grazing. Technical advisor have stated that given the management practises used it is highly unlikely that any active ingredients would have entered the food chain. We have been advised that we will be able to continue on with the current spray program using an alternative spray and achieve the same outcomes. The new product appears to be cheaper and will likely reduce the treatment cost and has a stated withholding period for grazed pasture that fits within our current management practices.
- Monitoring for 2017/18 will focus on understanding the growth rates, species composition and quality to gain more quantifiable data to compared control paddocks and establish the cost effectiveness of the treatments and returns/ha.
- The new paddock to be sprayed in October 2017 (105) will focus on timing of seed application, germination and grazing management to maximise plant persistence.

Spray program & grazing management summary

The following is a time line of the spray program and grazing management conducted during spring 2016 through to present, September 2017.

Date	Description	Comment
19th Oct, 2016	**Spray application:** 500 ml/ha of Valiant applied via helicopter.	Valiant is a selective herbicide for control of grass weeds in broadleaf crops. Going forward Centurion will be used.
October – December	**Resting paddock:** To allow subterranean and white clover to flower and set seed. No stock grazed.	Subterranean clover sending out runners and burying seed head in ground. White clover flowering heavily but cooler spring & summer meant seed set is delayed and forced to hold off on first grazing.
3rd Jan, 2017	**Light grazing:** 400 replacement ewe lambs grazed paddock.	Grazed yarrow seeds heads first, then clover and ryegrass leaf. Minimal grazing of white clover seed heads (this could allow potential to graze earlier)
17th Jan, 2017	**Stock removed:** 1200 kg DM cover left in paddock.	Lambs were removed from the paddock while the white clover seed heads were still present, hardening and becoming viable.
18th Feb, 2017	**Summer rain:** 25 mls rain	
1st Mar, 2017	**First natural seed strike:** Subterranean clover seedlings visible	Prior to next rain, first seedlings were starting to come under moisture stress. 'False' strikes can occur in late summer after summer rain followed by a dry spell.
12th Mar, 2017	**Summer rain:** 30+ mls rain	
25th Mar, 2017	**Second natural seed strike:** Subterranean clover seedlings visible	Now managing seedlings at two different growth stages.
21st April, 2017	**Aerial seed application:** 10 kg sub clover, 1 kg white clover	10 kg sub clover made up of 3.3 kg Antas, 3.3 kg Woogenellup, 3.3 kg Campeda 1 kg Apex white clover
22nd April, 2017	**Hoof & tooth:** 1500 ewes grazed, pre grazing cover approx 1800-2000 kg DM/ha	Pinch test done on naturalise clover seedlings to ensure no damaged occurs during grazing. Pasture quality approx 11 MJME/kg DM.
1st May, 2017	**Stock removed:** Ewes removed, post grazing cover 900kgDM/ha	Substantial soil moisture and seed/soil contact.

15th May, 2017	**First introduced seed strike:**	Excellent seed strike.
10th August, 2017	**Set stocked for lambing:** Pre grazing residual 1350kgDM/ha	6 stock units/ha, twin and triplet middle band scanned ewes.

Costings

We are currently of the mind that the best bang for our buck is through the Valiant treatment and naturalised seeding which equates to $190/hectare. Once you combine that with another aerial seeding the cost jumps to $393/hectare. Due to our location helicopter costs are higher than most farmers would have.

Estimations are that a naturalised seed set can done well can produce 400 kg clover seed per hectare, at a 5% strike rate that is 20 kg/ha clover at no cost. At $9.45/kg that is worth $189/ha.

100 Acres – Valiant Spring 2016, Seed Autumn 2017

* Going forward Centurion will be used instead of Valiant. Centurion is $79/litre, with recommended rates between 400 – 700 ml/ha. Per hectare rate for spray would then be $32 – $55 per hectare. We have yet to decide on application rates of Centurion, which will also require a mineral spraying oil to improve effectiveness of herbicide.

Item	Area	$/hectare
Valiant*	500 ml/ha x $180/L	*$90
Helicopter – chemical (spring)	12 hectares	$100
Helicopter – seed (autumn)	12 hectares	$100
Seed - Antas	$9.45 kg x 3.3 kg/ha	$31.19
Seed - Woogenellup	$9.45 kg x 3.3 kg/ha	$31.19
Seed - Capita	$9.45 kg x 3.3 kg/ha	$31.19
White clover	$9.45 kg x 1 kg/ha	$9.45
Total per hectare		***$393.02**

ANNUAL AND PERENNIAL GRASSES

To clover, grasses are evil competitors for water, light and nutrients (P, K, S). Some grasses are more evil than others.

The worst are browntop and Kentucky blue grass (*Poa pratensis*) which use rhizomes and stolons to spread and dominate sites making it difficult to introduce clovers.

Annuals grasses (e.g. barley grass, goose grass and Vulpia hair grass) are vigorous competitors against annual clovers when germinating with rain in autumn.

When annual grasses go reproductive in mid spring they are less attractive to stock, so sheep target the annual clovers.

To identify grasses in hill pastures look at them when flowering. In Plate 9 these annuals were all in full flower on 16 November 2017; they are keen to set seed before summer drought hits.

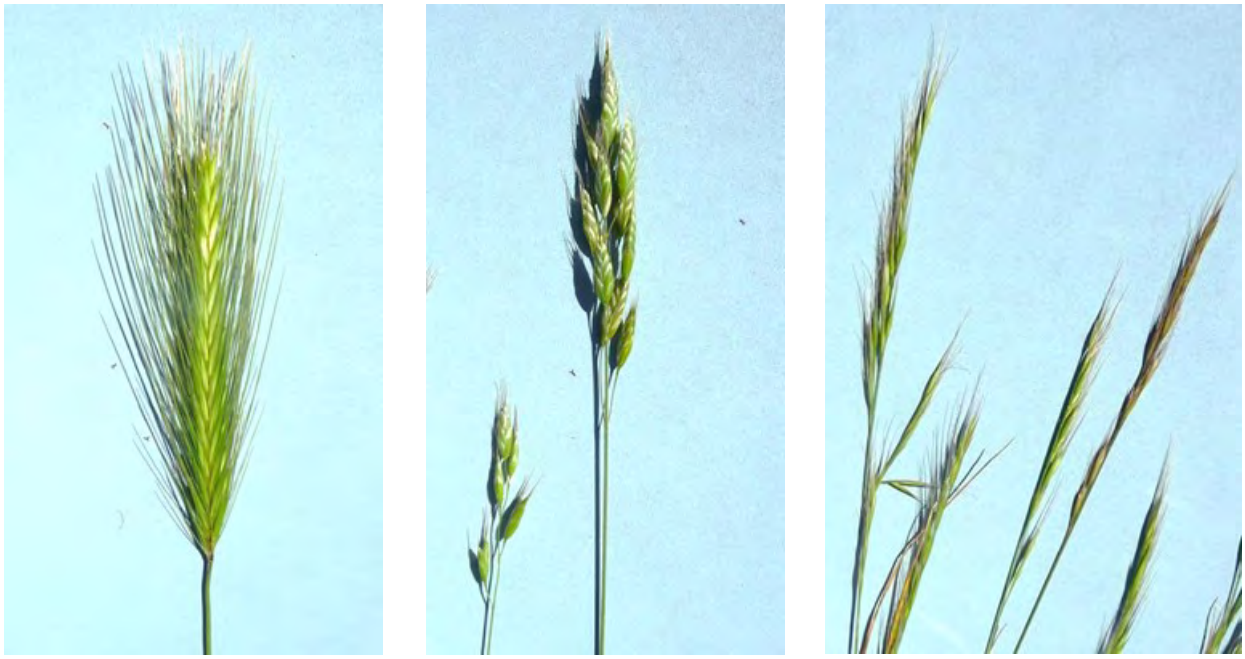


Plate 9: Seed heads of the three main annual grasses at the Koromiko site: barley grass (left), goose grass (centre) and Vulpia (right). Photos taken 16/11/17 by Dick Lucas.

Sweet vernal is the first perennial grass to flower. Ryegrass and Kentucky blue grass are next, followed by red fescue (Chewings fescue), and cocksfoot then tall oat grass which is just showing. Yorkshire fog flowers were yet to appear and blue wheat grass was a few weeks away. Other perennial native grasses such as danthonina species and silver tussock will be later.

The different flowering times of grass species at Koromiko are illustrated in Plate 10 and Plate 11 below.

Plate 10: From left to right: blue wheat grass and Yorkshire fog are yet to flower. Seed heads of tall oat grass, cocksfoot and ryegrass. Photo taken 16/11/17 by Dick Lucas.

Plate 11: From left to right are the seed heads of red fescue, *Poa pratense* and sweet vernal. Photo taken 16/11/17 by Dick Lucas.

LEGUMES

Common volunteer clovers (striated, suckling, cluster and haresfoot) are all present on Koromiko hill pastures along with some sub clover from earlier introductions. White clover is productive in some shady gullies with deeper soils and it may appear elsewhere in wetter than average years. There is no need to sow white clover - it is already present where it will survive.

Plate 12: Volunteer adventive annual clovers found at Koromiko: cluster clover (top left), haresfoot (top right), striated clover (bottom left) and suckling clover (bottom right).

Annual clovers are vital for success on summer dry hills (Plate 12). The average length of the dry season determines the sub cultivar to sow. On south faces with deep soils, late flowering sub clovers will thrive and persist. Where the vegetation dries off in November an earlier flowering sub cultivar should be mixed with a late variety – see the Sub clover guide for details.

All pasture legumes fix nitrogen at 25 to 30 kg N/t of legume dry matter produced. So a block with 33% clover DM that produces 6 t DM/ha/year has 50-60 kg N fixed for free.

The nutritive value of pasture in sub clover dominant patches at Koromiko during **late winter/spring** has crude protein of ~24% and ME 11.5 to 12 MJ/kg DM. This is because the clover dominant patches are preferentially grazed and the grass is kept

short and leafy. The grass also benefits from the N fixed by the clover in the patch. The grasses in N deficient areas between clover patches will have lower nutritive values which decline rapidly throughout spring/summer as reproductive tillers mature.

The effect of preferential grazing on clover patches and associated grass up to 10th October, when ewes and lambs were moved, is illustrated in Plate 13.

Plate 13: A sub clover plant that has been preferentially grazed hard by the ewes in the experimental block at Koromiko. (7/9/17, Photo: Sonya Olykan).

RAINFALL

The nearest weather station is ECAN's Lowry Hills station (no. 237101) which is 2.5 km from the experimental site and only measures rainfall only.

Total annual rainfall during the last six years has been variable with 2015 and 2016 having < 500 mm (Figure 3).

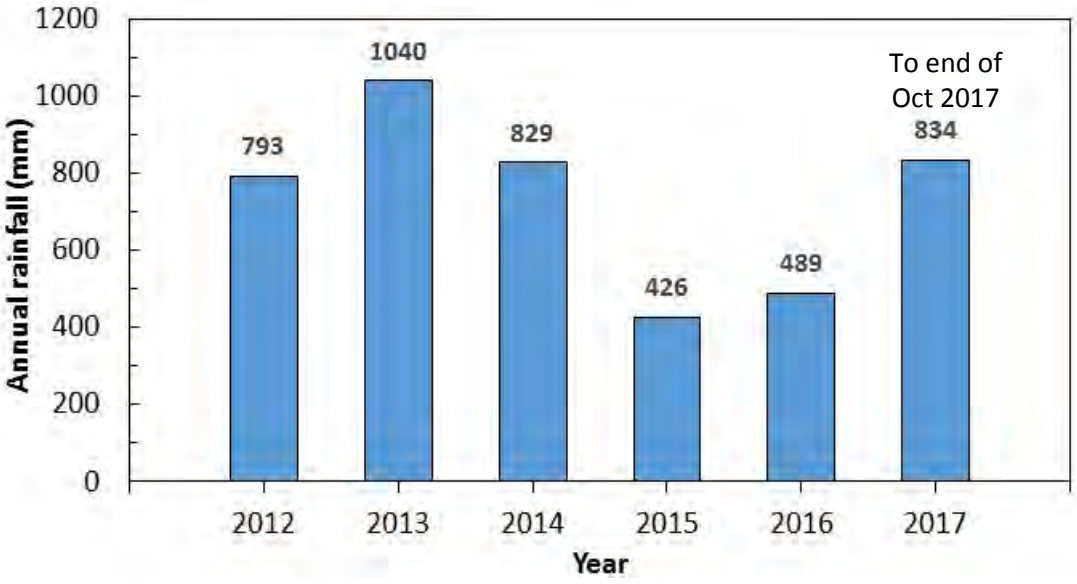


Figure 3: Annual rainfall at Koromiko, North Canterbury (Lowry Hills, ECAN 237101).

The 2016 autumn and winter monthly rainfall amounts were low. Rainfall in spring averaged ~ 50 mm/month (Figure 4).

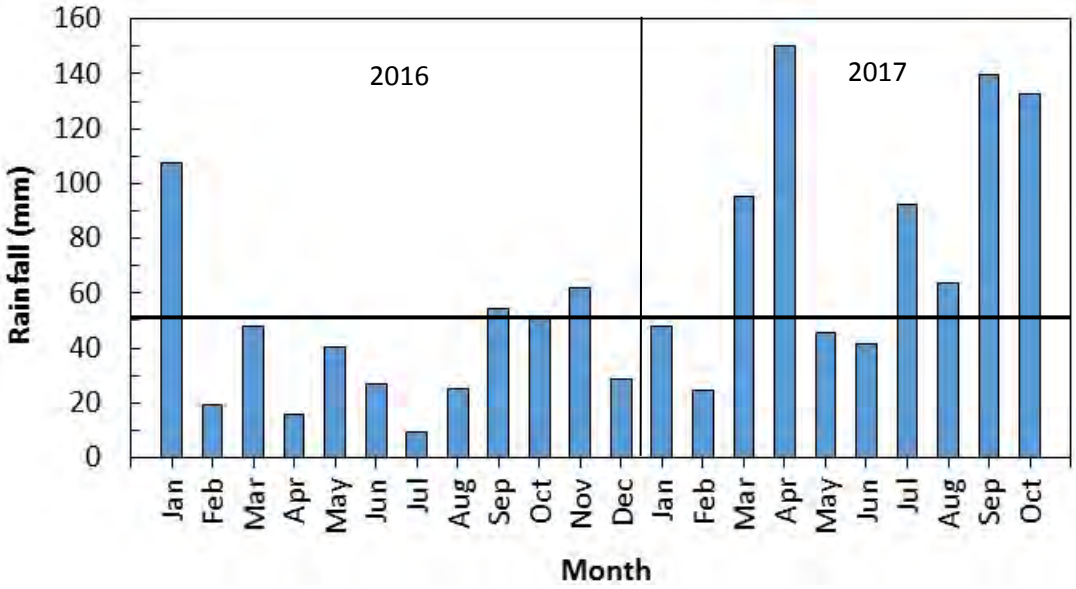


Figure 4: 2016-17 monthly rainfall at Koromiko, North Canterbury (Lowry Hills, ECAN 237101). The black line is at 50 mm.

The 2017 year started with low rainfall in January and February (48 and 25 mm) but the key months for sub clover germination and growth, from March onwards, had good levels of rainfall that replenished the soil moisture levels.

SOILS

The predominant soil in the experimental area is Omarama Rock (Typic Rocky Recent Soil) that is characterised as being very shallow (depth 5 -39 cm) and well drained with very low plant available water (30 mm in the top 1 m).

In October 2015, 3 soil samples, from 0-75 mm depth, were taken from across the experimental area. Analysis found that there was little variation in pH and amounts of nutrients between the 3 sites:

- pH of 5.2-5.3 was low[3],
- Olsen-sol P of 14-17 µg/mL was low,
- Sulphate-S of 3 to 4 µg/g and extractable organic-S of 6-9 µg/g were low,
- Ca of 7 to 10 me/100g (QTU of 7-9) was adequate,
- K of 0.8 to 1.0 me/100g (QTU of 12-16) was high, and
- Mg of 1.9 to 3.0 me/100g (QTU of 35 -50) was high.

Historically the site receives 150 kg sulphur-super-20 fertiliser every second year.

EXPERIMENTAL DETAILS

The experimental area at Koromiko Farm is typical of uncultivatable hill country found in the North Canterbury Lowry Hills. The terrain is variable across relatively short distances resulting in a mix of aspects, soil types and vegetation – both introduced pasture species and native species such as tussock and matagouri.

The experiment area (360-380 m a.s.l.) has two 'sites' of interest – 4 ha of sunny face and 8 ha of shady face. This 12 ha is within a 34 ha block that is regularly grazed with sheep and cattle.

Objective

Identify options for establishment of sub clover through oversowing.

Experimental design and establishment

The experimental design was based on three herbicide treatments and the oversowing of a mixture of four sub clover cultivars.

Herbicides

Pre-sowing herbicides were applied by a helicopter to designated treatment strips across the area. The three herbicides treatments were:

- ♣ 6 L/ha Roundup,

[3] Categories on the Soil Analysis report from Analytical Research Laboratories.

- ♣ 1 L/ha Roundup, or
- ♣ 3 L/ha Reglone.

Each herbicide was applied to the same respective strip on three dates throughout the dry summer period (Table 4). The herbicide strips and untreated 'control' strips were replicated across the site (Figure 5).

Table 4: Site preparation events prior to the establishment of the experiment.

Date	Event
09/11/15	Treatment herbicide application 1
12/01/16	Treatment herbicide application 2
22/02/16	Treatment herbicide application 3
30/03/16	Basal fertiliser application - 200 kg Sulphur Super-20/ha*. Same day as seed was flown on.

* P 8, S 20.6, Ca 18. At 200 kg/ha added 16 kg P, 41 kg S and 36 kg Ca/ha.

Figure 5: Location of GPS points and approximate location and orientation of the herbicide spray strips applied to Koromiko Farm, North Canterbury.

Sub clover

On 30/3/16 the experimental site was oversown with a 10.9 kg/ha equal parts mixture of four subterranean clover cultivars - Antas, Denmark, Narrikup and Woogenellup - using a helicopter.

Following application, a mob of ewes was run over the area to help the seed make contact with the soil.

The following identification photos for the sub clover cultivars sown at Koromiko, are from the Sub Clover guide (photos taken by David Hollander).

Antas: Trifoliate leaf

Stipule

Flower

Denmark: Trifoliate leaf

Stipule

Flower

Narrikup Trifoliate leaf **Stipule** **Flower**

Woogenellup: Trifoliate leaf **Stipule** **Flower**

Management of the experimental area

The grazing management of the site has included sheep and cattle (Table 5).
The paddock was closed during two key times of the sub clover life cycle:

- ♣ germination and establishment (mid-March to mid-April 2017) and
- ♣ reseeding for up to several months (from 1st October 2016 and 10th October 2017).

Table 5: Diary of grazing management of the Koromiko site from December 2015 to October 2017. Information provided by Hugh Dampier-Crossley.

Date	Event
9/11/15	*First aerial herbicide application*
Mid-Dec 2015	Heavily grazed with ewes post weaning
8th Jan 2016	Light grazing with 850 ewes for 4 days
12/01/16	*Second aerial herbicide application*
22/02/16	*Third aerial herbicide application*
24th Feb	Put 150 cows and calves into block
26th Feb	Took cows out and put 1200 ewes into block
16th March	160 weaned cows into block taken out 21st March having chewed down hard.
30/03/16	*Oversowing of sub clover seed and basal fertiliser application*
1st April	Tramped seed in with 1100 rom 2ths
25th August	Set stocked 60 ewes to lamb
1st Oct	Ewes taken off to shut up for seeding
Mid-Feb 2017	133 cows plus calves grazed for about 1 month
Mid-March	Shut up for seed strike
13th April	81 cows grazed for 10 days
2nd August	200 single ewes grazed until 16th of August
20th August	50 late twins set stocked
10th October	Ewes and lambs removed from block

RESULTS & DISCUSSION

Establishment of sub clover

On 22 Sept 2016 sub clover populations were counted in 20 randomly placed 0.5 m^2 quadrats in each of the pasture zone areas in the experimental area (Figure 6). These zones represented the diversity of introduced pasture species and native plants that occupy the site.

The establishment of oversown sub clover in 2016 was relatively successful in spite of delayed oversowing and the lower than average rainfall (Figure 4). Populations were low across the experimental area, averaging 10 plants/m^2, in the first year (Figure 7).

Sites that favoured initial sub clover establishment were:

- tracks – bare ground and less competition,
- sprayed ridge - vegetation cleared by herbicide application, and

- gully green – northerly facing.

It is probable that grass competition in the shadier, and therefore moister, aspects of the site resulted in lower sub clover populations (e.g. pasture & tussock).

Figure 6: Location of pasture zones and a control area that were assessed for sub clover establishment on Koromiko Farm, Cheviot (aerial image retrieved from Google maps). The parking spot is noted for reference.

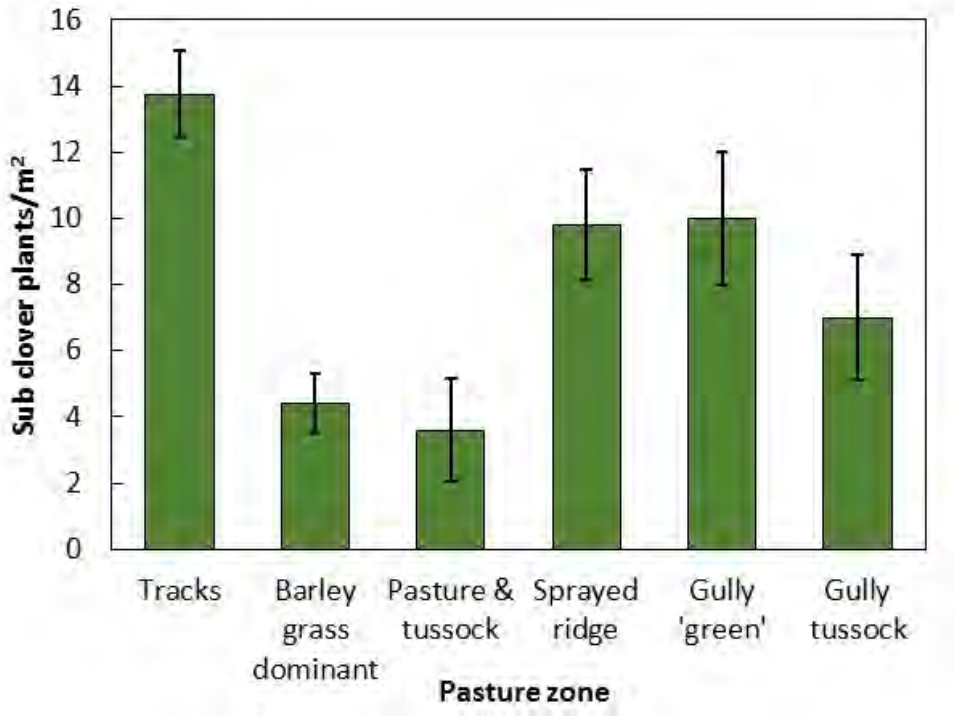


Figure 7: Sub clover establishment in the pasture zones on 22 Sept 2016 at Koromiko Farm, North Canterbury.

About 6% of the oversown seed established. Under better conditions we could expect two or three times this success rate.

In 2016, the optimum sowing date of late February early March was missed as it was very dry. The established sub clover populations were low, but not hopeless, and have required two spring seasons of grazing management to increase the population.

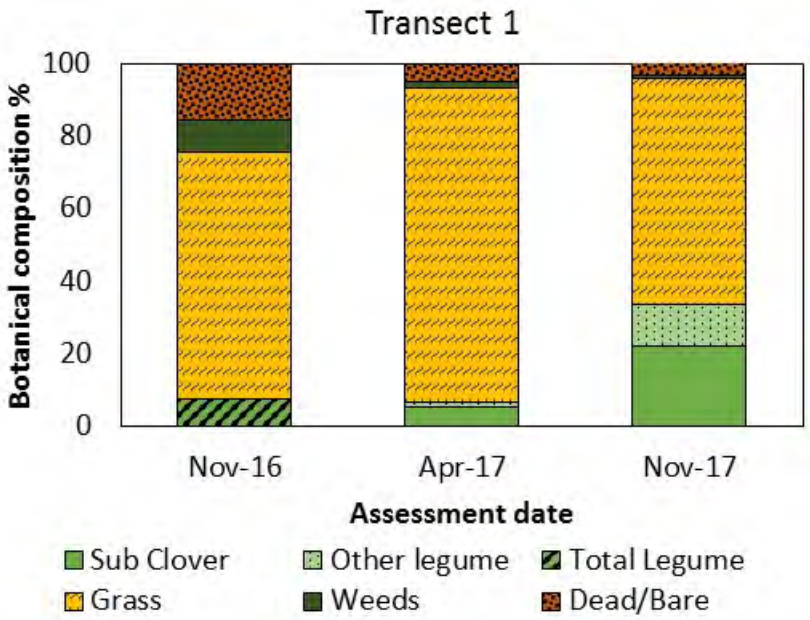
This management also assisted the resident clovers which were not seen on the initial site visit.

BOTANICAL COMPOSITION

At three positions along the north-east slope, a 20 m transect line was placed from near the main track going down the hill. At 2 m intervals along the transect line the botanical composition of the pasture, based on the ground cover percent of clover (sub clover and other clovers) grass, weeds and dead material/bare ground, was assessed in November 2016 (total legume is all clovers including sub), April 2017 (when the annual clover plants were small) and November 2017.

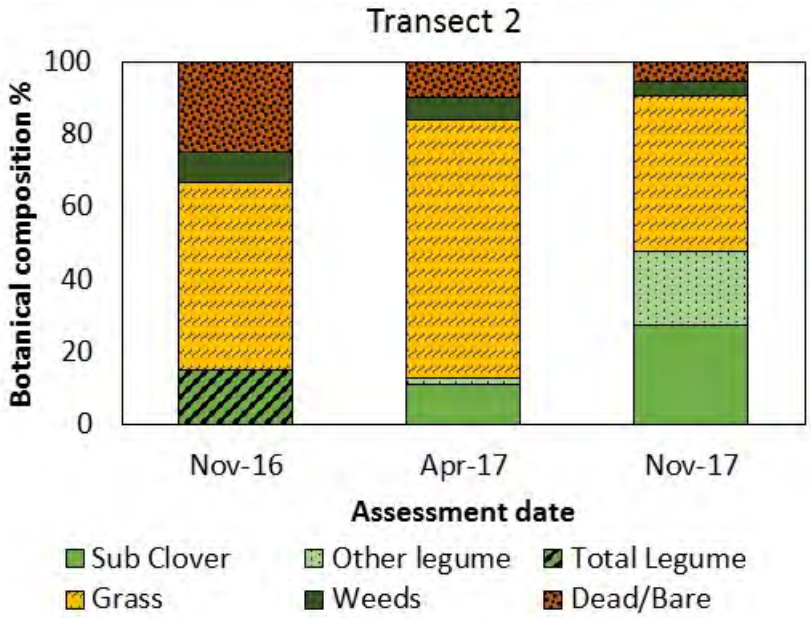
Transect 1 – annual grass dominant

- Transect 1 - north-east slope dominated by annual grasses.
- November 2016 the total legume content has increased from 8 to 34%.
- November 2017 sub clover was the dominant legume at 22% of the ground cover.



Transect 2

- Transect 2 is on a good, easy north-east slope.
- November 2016 the total legume content was 15 and increased to 47% by November 2017.
- November 2017 sub clover was 27% of the ground cover. Other clovers also present included suckling, haresfoot, and striated.



Transect 3 – spray strip

- Transect 3 is located in a herbicide treatment strip that was sprayed with 6 L/ha of Roundup in the summer of 2015/16.
- November 2016 the total legume content was 46% as a result of the removal of the grass competition – grass was 13% of the ground cover while weeds, e.g. sorrel, were 38%.
- April 2017 sub clover was 22% and at the same level in November 2017. During this time other annual clovers have also appeared and were 22% of the ground cover. At this time this transect is very similar to the one at Transect 2. This suggests the initial herbicide was not required to establish sub clover. The grazing management strategy has encouraged sub and other annual clovers to thrive.

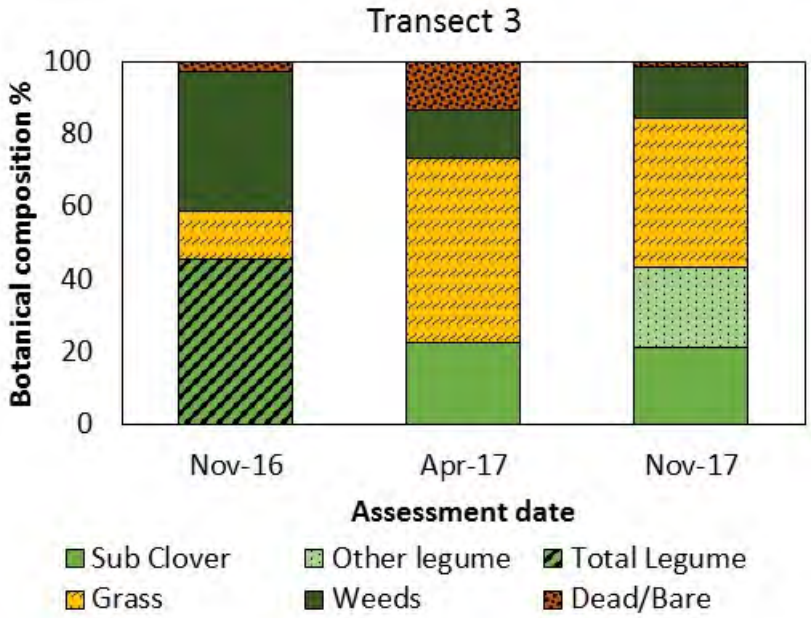


Plate 14: High rates of herbicide may result in the invasion of unwanted weeds. Koromiko Farm, North Canterbury (28/11/16, photo: Dick Lucas)

Graze and amaze!

Plate 15: The landscape at Koromiko is variable and this is reflected in the soil's varying chemical and physical characteristics (Photo taken 16/11/17 by Dick Lucas).

Mt Benger Alice's block revisited

Dick Lucas and Andrew Johnston (Luisetti Seeds)

[Mt Benger is a 3420 ha farm located south of Culverden near Ben Lomond. The topography is a mix of river flats and terraces (13%), easy down land (23%), medium hill country (6%) and uncultivatable hills (58%).]

At the Mt Benger Field Day on 1 November 2013, after a moist year, visitors saw the results of outstanding establishment of sub clover based pasture sown on 1 February 2013 (Plate 16).

Plate 16: Cultivated area on Alice's Block, clover canopy 25 cm high on 20 May 2013.

However the result on the uncultivated steeper parts of Alice's was most relevant to large areas of summer dry hill country (Plate 17).

During recent drought years Alice's suffered very close grazing. The wet autumn, winter and early spring this year (2017) has resulted in excellent sub clover based pastures on both cultivated and uncultivated areas of Alice's

Plate 17: Sub clover establishment on uncultivated Alice's west face after seed broadcast 1 February 2013. Photo taken October 2013.

Plate 18: September 2017:- Sub clover pasture on cultivated area in foreground and middle distance on right and sub clover thriving on uncultivated steeper slopes with matagouri and 'native' grasses.

Pasture regeneration and gorse seedling control in the Port Hills following fire

Breanna Taylor and Derrick Moot

This research examined the regeneration of pasture after the Port Hills fire on 17/2/17.

Subterranean establishment

Results found that subterranean clover seedling establishment ranged from 38 plants/m^2 in the unburnt pasture to 648 plants/m^2 in the burnt pasture (Table 6). This was due to the heat from fire breaking the subterranean clover hard seed. The fire also removed resident pasture material allowing greater light interception by the seedlings.

Table 6: Subterranean seedlings (plants/m2) on burnt, partially burnt and unburnt pastures on the Port hills, Canterbury on two measurement dates.

Date	Burnt	Partially burnt	Unburnt
28/03/17	648 a*	88 b	38 b
21/04/17	375 a	93 b	28 b

* For each date, means with the same letter were not significantly different (LSD 5%)

Plate 19: Subterranean clover seedlings in burnt pasture, Early Valley Road farm on the Port Hills. Photo taken on 04/04/2017 by Breanna Taylor.

Botanical composition

Counting individual seedlings was impossible by the end of March so quadrat cuts were taken for assessment of botanical composition.

The burnt pasture had the highest (P<0.05) amount of grass (64.4%) and clover (4.75%) compared with the other pasture areas on the 4th April (Table 7). The burnt pasture also had the lowest proportion of dead material (P<0.001). These results highlight that the partially burnt and unburnt pastures were almost 50% dead material. See Table 7.

Table 7: Botanical composition (%) of burnt, partially burnt and unburnt pastures on the Port Hills, Canterbury on the 04/04/17.

Date/Treatment	Grass	Clover	Dead	Weeds
04/04/17				
Burnt	64 a	5 **a**	18 *b*	13
Partially burnt	46 b	2 **b**	48 *a*	5
Unburnt	38 b	3 **ab**	46 *a*	13
27/06/17				
Burnt	50 b	44 **a**	0 *b*	6
Partially burnt	69 a	23 **b**	0 *b*	8
Unburnt	78 a	14 **b**	5 *a*	3
16/08/17				
Burnt	48 b	49 **a**	0 *b*	3
Partially burnt	78 a	18 **b**	0 *b*	5
Unburnt	79 a	8 **b**	9 *a*	5
05/09/17				
Burnt	63	27 **a**	7 *b*	4
Partially burnt	77	7 **b**	9 *b*	6
Unburnt	63	4 **b**	30 *a*	3

* For each date, component (i.e. grass, clover, dead or weed) means with the same letter were not significantly different (LSD 5%).

The burnt pasture had a lower (P<0.001) proportion of grass and a higher (P<0.001) proportion of clover compared with the partially burnt and unburnt pastures when visually assessed on the 27th June and 16th August (Table 7). The composition of the pastures did not change between the two sampling dates. However, the clover content increased from 44% to 49% in the burnt pasture and decreased from 13.8% to 7.5% in the unburnt pasture.

By 5th September clover was highest (P<0.017) in the burnt pasture, making up 26.5% of the total DM compared with <8% in the unburnt areas. Dead material was highest (P<0.003) at 30.1% in the unburnt pasture.

The amount of clover in the burnt pasture increased from 4.75% on the 04/04/17 to 26.5% on the 05/09/17. The emergence and growth of the subterranean clover was affected by competition with the grass species.

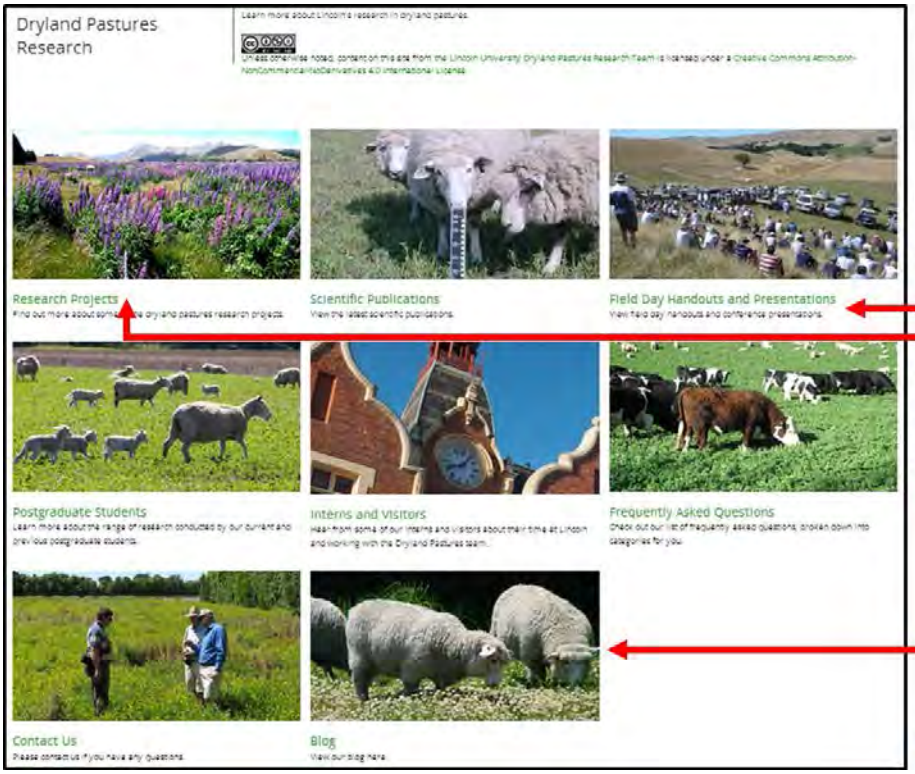
Plate 20: Unburnt pasture, Early Valley Road farm on the Port Hills. Photo taken on 04/04/2017 by Breanna Taylor.

Hard grazing to remove the tag could produce the same sub clover emergence. This is a low fertility site (Olsen P of 6) that would benefit from fertiliser and fencing.

Website & Social Media

Keep up-to-date with the latest news and results from the Dryland Pastures Research Team:

- 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
- Direct link to Blog

www.lincoln.ac.nz/dryland

- Blog: https://blogs.lincoln.ac.nz/dryland/
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Sub 4 Spring and DPR supporters

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