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Summary of latest live weight gain data from the legume grazing trials at Lincoln University and strategies for sub clover management

Produced by the

Dryland Pastures Research Team

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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."

DPR solutions for dryland pastures: 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)!

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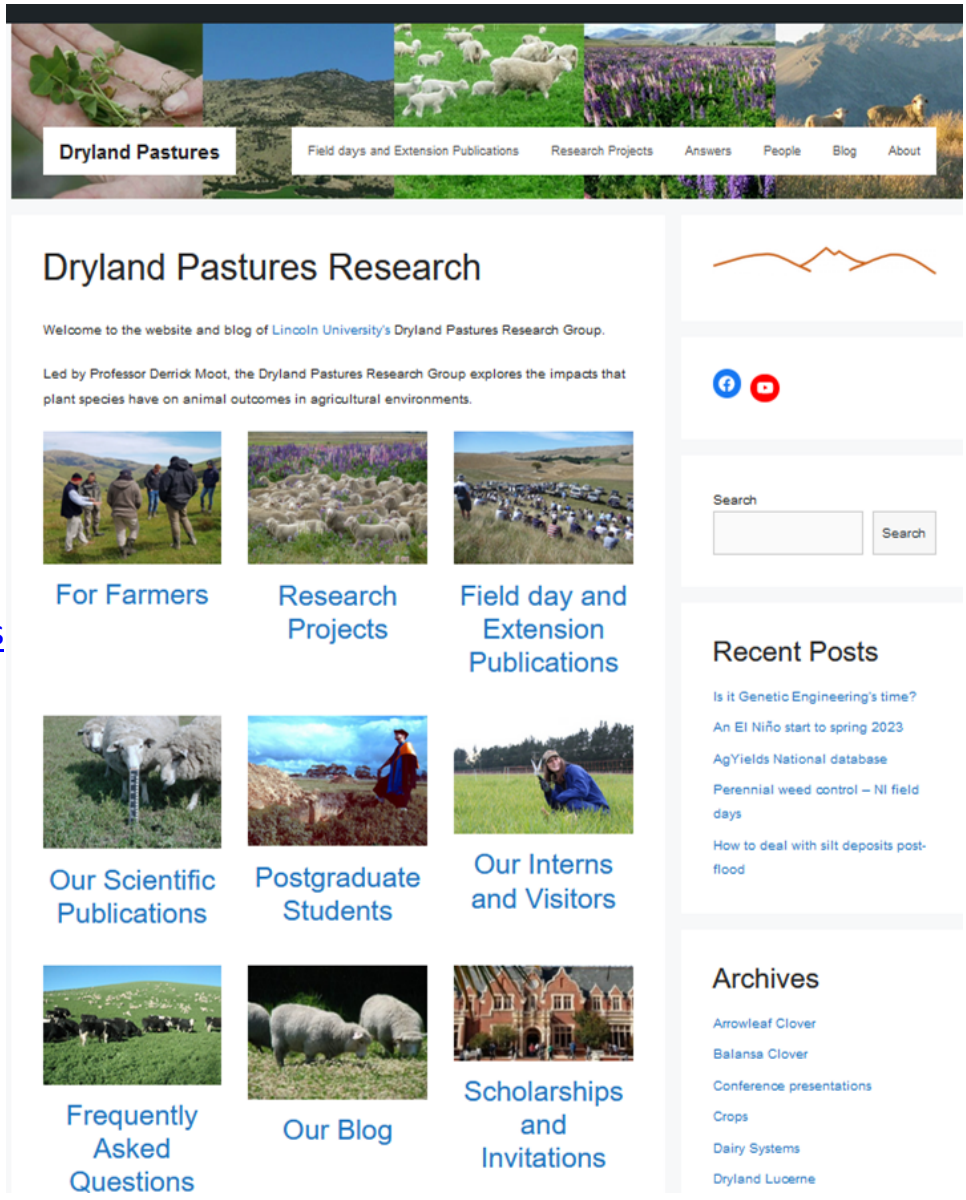

Ashley Dene – MaxAnnuals

Dr Alistair Black, Dick Lucas, Malcolm Smith and 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) grazing experiment

- Established in paddocks C9A(N) and C9B(N) (total area 8.04 ha)
- Four pastures, replicated four times, were sown on 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 2013 and 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.

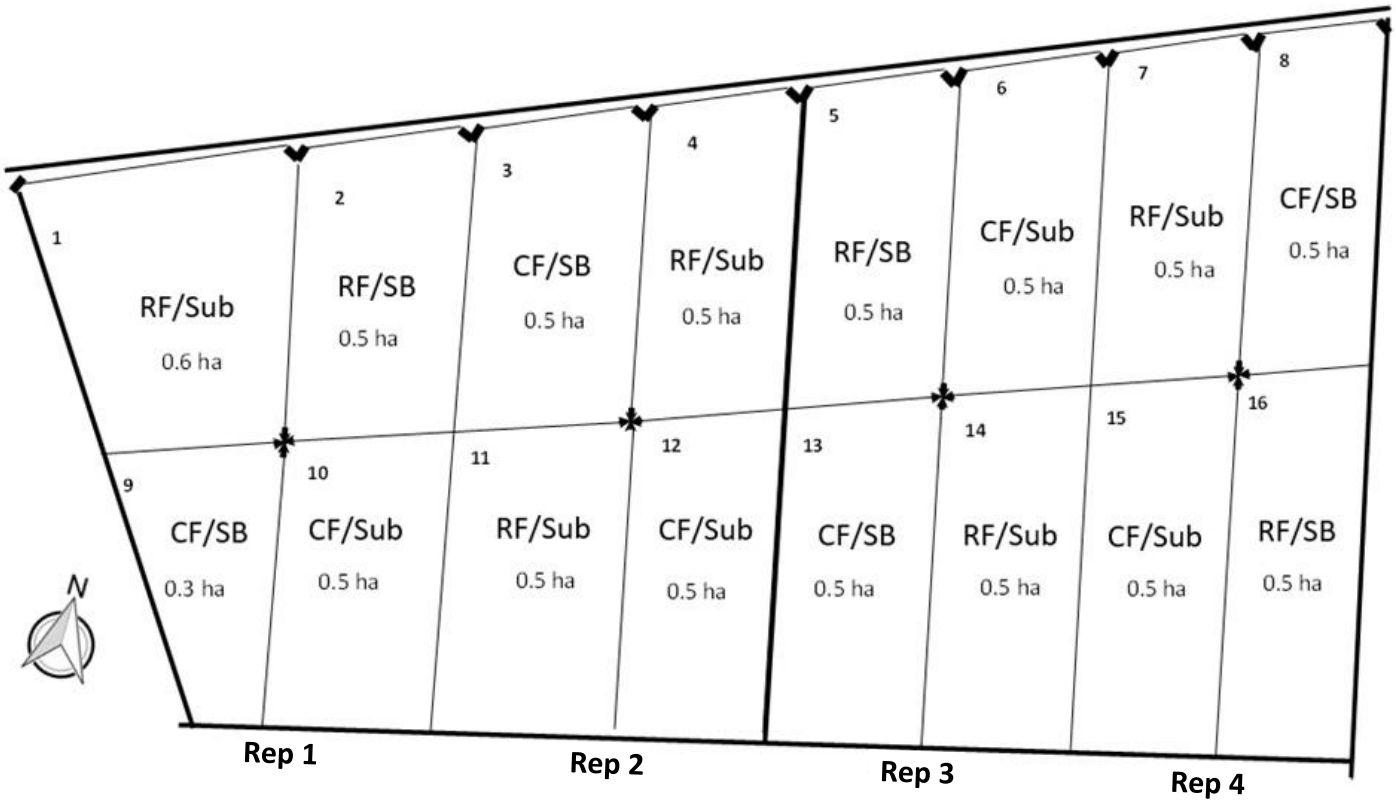

Figure 1: Experimental plan of the MaxAnnuals clover based pastures in paddocks C9A&B(N) at Ashley Dene, Canterbury, sown autumn 2013. Codes: CF = cocksfoot, RF = Ryegrass/Fescue, SB = subterranean + and balansa clovers, Sub = subterranean clover. See Table 1 for cultivars and sowing rates.

Table 1: Sowing rates (kg/ha) of species and cultivars used in the dryland pastures established 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 clovers		White clover	Plantain	Balansa	RG x TF hybrid 'Ultra	Cocksfoot
Pasture	**'Rosabrook'**	**'Denmark'**	**'Nomad'**	**'Tonic'**	**'Bolta'**	**Enhanced'**	**'Greenly'**
CF/Sub	5	5	0.5	0.5	0	0	2
CF/S+B	5	5	0.5	0.5	4	0	2
RF*/Sub	5	5	0.5	0.5	0	10	0
RF*/S+B	5	5	0.5	0.5	4	10	0

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

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

RESULTS

Rainfall - 2013-2017

Monthly rainfalls at Ashley Dene, from July 2013 to December 2017, are shown in Figure 2.

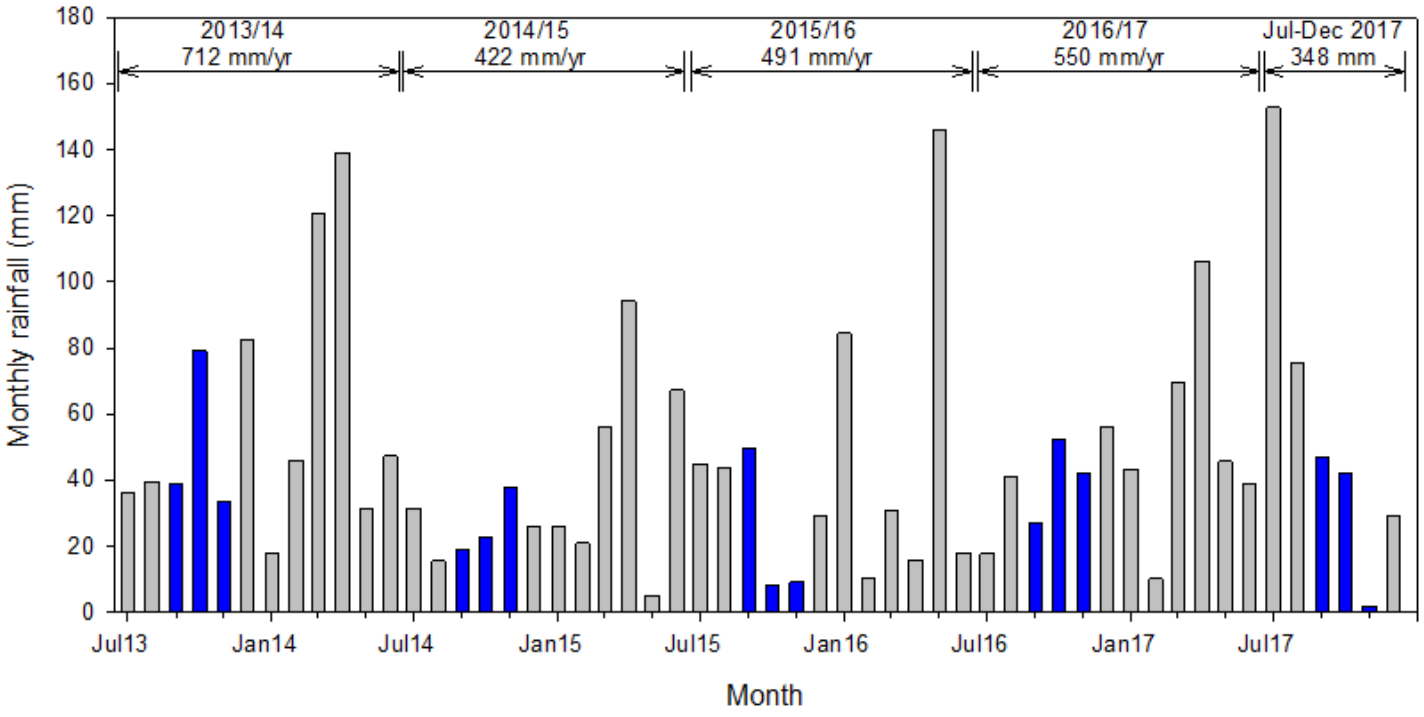

Figure 2: Ashley Dene monthly rainfall from July 2013 to December 2017. The blue bars are spring: September to November. Annual July to June rainfalls are noted at the top.

MaxAnnuals results (years 1-5)

Pre-weaning lamb LWt production (kg/ha)

The total pre-weaning twin lamb LWt production is shown in Table 2. The pastures were grazed by hoggets in 2013/14 so no lamb data available.

Table 2: MaxAnnuals total pre-weaning twin lamb LWt production (kg/ha) in spring.

Pasture	2013/14	2014/15	2015/16	2016/17	2017/18
CF/Sub	-	297	163	160	246
CF/S+B	-	290	177	172	252
RG/Sub	-	329	191	165	273
RG/S+B	-	306	224	160	275
Mean	**-**	**306 a**	**189 c**	**164 c**	**261 b**

There were no differences among pastures but production did differ between years reflecting differences in quality and quantity of feed available in the lactation phase.

Total pre-weaning twin lamb LWt/ha production in 2017/18 was 60% higher than in 2016/17 (Table 2). A comparison of the pasture clover content and yield for these two spring seasons is shown in Table 3. In 2016/17 the average pasture clover content was 7% and the yield was 0.28 t DM/ha. In 2017/18 the average pasture clover content increased to 45% and the yield was 2.4 t DM/ha.

Table 3: Average total clover % and total clover yield in spring for the last two years of the MaxAnnuals experiment at Ashley Dene, Canterbury. Data are based on composition from the first two cage cuts for the season.

		Total clover %	Total Clover yield (t DM/ha)
2016/17	CF/Sub	4.2	0.14
	CF/S+B	8.3	0.29
	RG/Sub	4.8	0.22
	RG/S+B	10.6	0.48
2017/18	CF/Sub	42.5	2.18
	CF/S+B	43.3	2.17
	RG/Sub	48.1	2.95
	RG/S+B	46.0	2.49

Note: in these last two years little ryegrass remained and plantain was the major non clover component contributing to total yield.

Seasonal Weighted LWt gains (g/hd/d)

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 3.

♣ Spring LWG of twin lambs at foot was reasonably consistent from the initiation of grazing to either weaning or destocking across the four annual clover based pastures and averaged 327 g/hd/d for twins between 2014/15 and 2017/18.

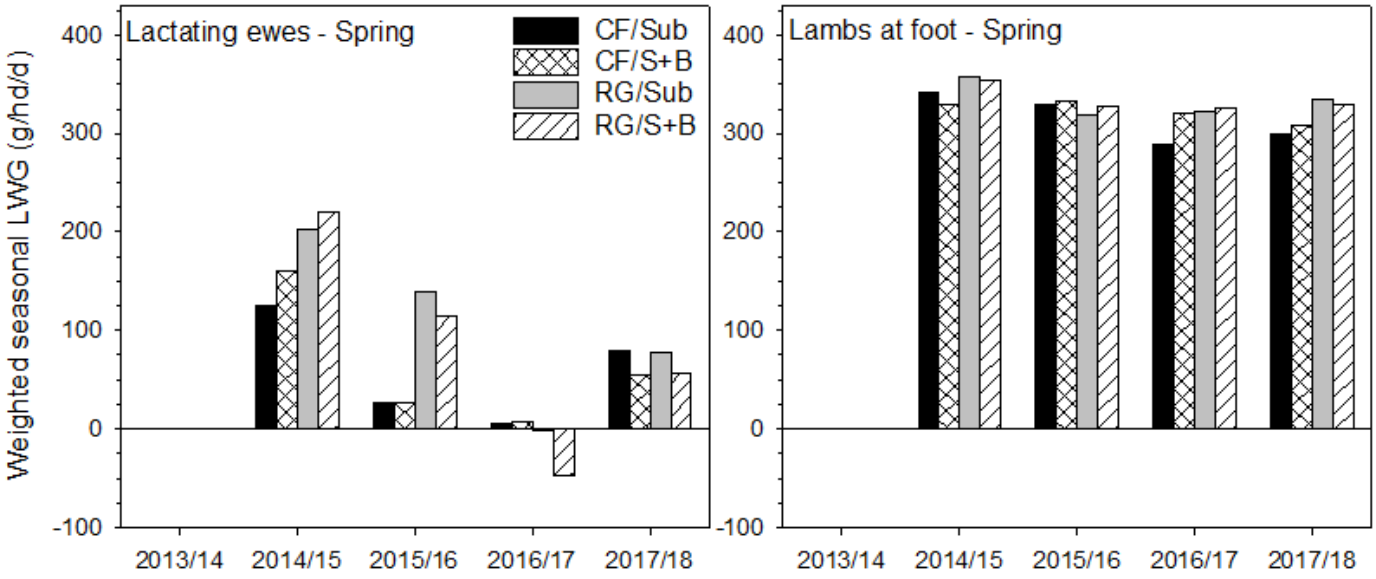

Figure 3: Seasonal weighted LWt gain (or loss) of lactating ewes and twin lambs at foot grazing one of four dryland pasture treatments at Ashley Dene, Canterbury over four growth seasons (Note: hoggets grazed in the first year).

For twin lambs to grow 300 g/hd/d or more, the ewes also need to be gaining weight – at least 60 g/hd/d as indicated by the dotted green lines on Figure 4. This requires quantity and quality of feed which can be achieved with a number of lucerne and legume + grass combinations (Figure 4).

Pasture dry matter production in MaxAnnuals

Annual yield differed between pasture treatments in Years 1 to 4 (Figure 5). Total DM yields of the CF based pastures were superior to those of the RG based pastures. In 2013/14 (Year 1) CF pastures produced 12000 kg DM/ha which was 18% more ($P<0.05$) than the 10100 kg DM/ha from the RG/Sub pasture. Total DM yields were high in Year 1 because of the early close up for reseeding and the above average annual rainfall (Figure 2). 2014/15 was the first of a series of El Nino years with below average rainfall. Total yield from CF based pastures was 12200 kg DM/ha which was 15% greater ($P<0.001$) than the 10600 kg DM/ha produced by the RG based pastures. Ryegrass pastures were oversown with perennial RG seed in April 2015 and closed to allow seedlings to establish.

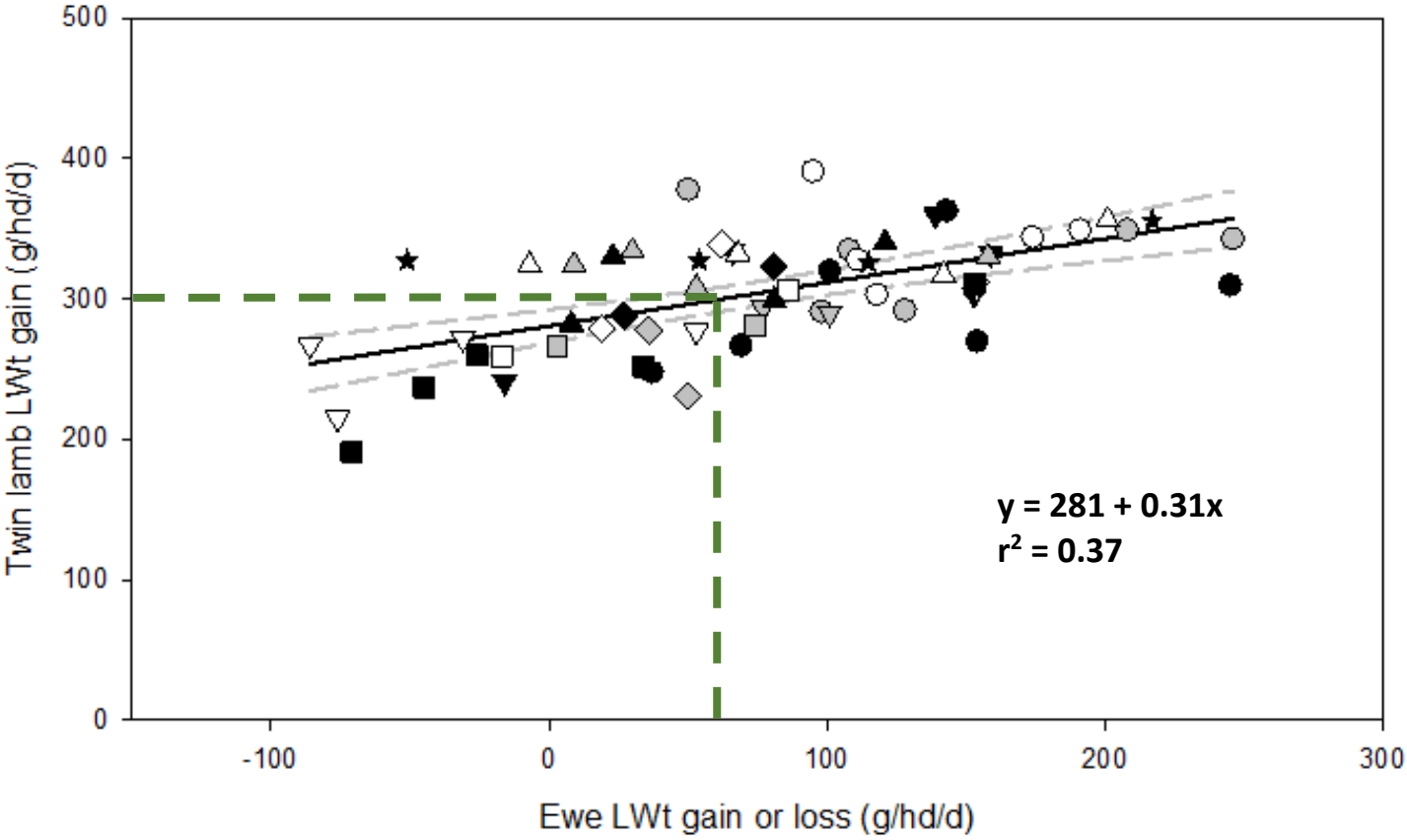

Figure 4: Collated data graph showing relationship between twin lamb LWt gain (g/hd/d) and ewe LWt gain (g/hd/d) during the lactation phase. Data was sourced from four dryland experiments (H7, MaxLucerne, MaxAnnuals and MaxClover) and represents a total of 16 different pasture or grazing treatments over 4 years. Legend:

- Luc Rotational (H7)
- Luc SS (H7)
- Luc Semi SS (H7)
- Luc (MaxLucerne)
- Luc (MaxClover)
- Luc/brome (MaxLucerne)
- Luc/CF (MaxLucerne)
- CF/Bal (MaxClover)
- CF/Cc (MaxClover)
- CF/Sub (MaxClover
- CF/Wc (MaxClover)
- RG/Wc (MaxClover)
- CF/Sub (MaxAnnuals)
- CF/S+B (MaxAnnuals)
- RG/Sub (MaxAnnuals)
- RG/S+B (MaxAnnuals)

Codes: Luc = lucerne, SS = set stocked, CF = Cocksfoot, Bal = Balansa clover, Cc = Caucasian clover, Sub = Subterranean clover, Wc = white clover, RG = ryegrass, S+B = Subterranean + Balansa clovers.

The lack of difference in corresponding LWt production occurred because the majority of the yield differences occurred in the summer period, and this was associated with a series of 'maintenance' grazing events when LWt production was not determined. In Year 3 (2015/16) yields ranged from 5080 ($P<0.05$) in the RG/Sub pastures to 6700 kg DM/ha from the CF/S+B pasture. Between Jul 2016 and Feb 2017 CF based pastures yielded 6740 kg DM/ha which was 33% more ($P<0.05$) than the 5060 kg DM/ha produced by the RG/Sub pasture.

For the spring of 2017/18, pastures accumulated 6762 kg DM/ha prior to destocking in November and no effect of pasture type was observed.

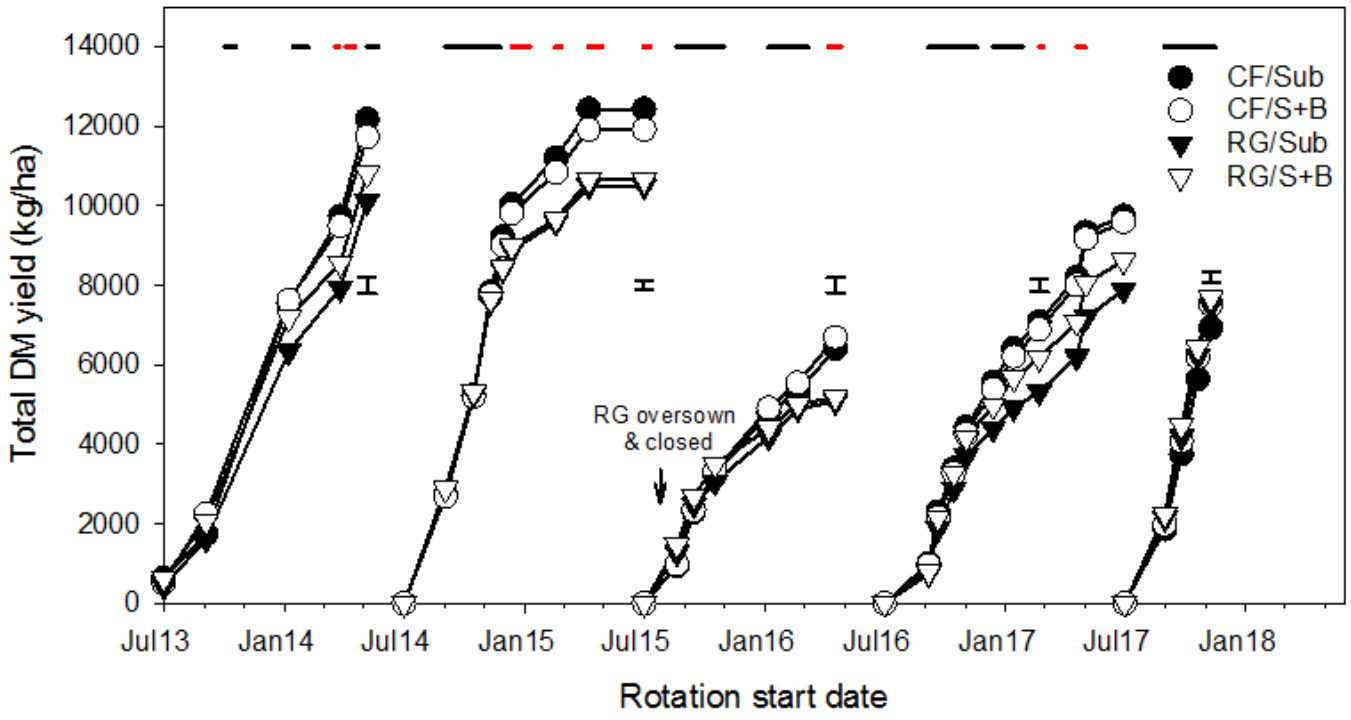

Figure 5: Accumulated total DM production (kg DM/ha) of cocksfoot (F) or perennial ryegrass (RG) based pastures established with either subterranean clover (Sub) or subterranean and balansa clovers (S+B). Black horizontal lines indicate "production" grazing events. Red horizontal lines are "maintenance" grazing events. In Year 1 hoggets grazed to set up the seed bank. In subsequent years ewes with twin lambs at foot grazed in spring.

The Solution:

Dryland pasture systems for the production of high quality feed in spring that enables lamb growth rates of 300+ g/hd/d are lucerne, on the best and deepest cultivatable soils, or annual clovers in drier areas including uncultivatable hill country.

NOTES:

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 may be acceptable for improvement through grazing without reseeding.
- Given the opportunity, the sub clover runners will extend the patch up to 60 cm in diameter in a season with late spring spelling.

Plate 1: '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 of Mt Barker 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 (pages 8 & 9)
2. Low or no resident sub clover - plan to oversow the following autumn (page 10)
3. Drilling sub clover into existing pasture (pages 11 & 12)

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 NB: sub clover flowers are small (see Plate 2). Spell the paddock for four to five weeks and 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 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 20 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 is 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. Then graze, preferably with cattle, to control grass competition.
Winter	**Graze as required** Keep pasture above 1200 kg DM/ha. If possible spell lambing paddocks to build clover rich pasture for lambing. Pasture with >40% clover is great feed for lactating ewes

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

Plate 2: Sub clover flowers are small - about 10 mm long and 3-4 mm wide. Mt Barker (left), Narrikup and Rosabook have red-banded flowers which helps with cultivar identification in the spring. Antas (right), Coolamon, Denmark, Karridale, Tallarook and Woogenellup flowers have no bands. Photos: David Hollander.

Plate 3: 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 necessary 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 and keep records of clover% per paddock.

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]. Ideally soft seeded and late flowering for most areas. ♣ Soil test – check recent results or get soils tested Check 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 kg DM/ha. Opening up the pasture will aid resident and oversown sub clover seed germination
Mid-March	**Oversow with sub clover seed & apply fertiliser if required** **Monitor rainfall and watch for sub clover germination** Sub clover germination is 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 DPR blog posts.

Oversowing costs at Koromiko, North Canterbury

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 photo shows 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 4: Strip sown sub clover on part of paddock 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:** ♣ Soil test – check recent results or get soils tested Check that pH is > 5.6, Olsen P is 15-19, and Sulphate-S > 8. ♣ Investigate sub clover cultivar options[2]. Ideally soft seeded and late flowering for most areas. ♣ 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 kg DM/ha Opening up the pasture will aid sub clover seed germination and establishment
February (if soil is moist) to mid-March	**Drill sub clover seed and apply fertiliser and lime if required** **Monitor rainfall and watch for sub clover germination** Sub clover germination is 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 – usually early October** 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 DPR blog posts.

‘Sub 4 Spring’ – some take-home messages for clover enthusiasts

1. Regular applications of superphosphate will not magically increase clover content of summer dry pastures without specific grazing management to favour annual clover species.

2. Ensure clovers have optimum nutrient supplies by getting soil and leaf analyses done so the right type and amount of fertiliser is spread. The paddock will then produce over 500 kg/ha seed if it is spelled for about eight weeks after sub clover has been flowering for two weeks.

3. Twin lambs will grow at over 300 g/head/day if 40% of pasture dry matter on offer in Sept/Oct is clover.

4. Note that if you can see clover foliage covering about 80% of the visible leaf canopy it probably amounts to only 40 % of the actual dry matter on offer.

5. Spring is the money making time, exploit the lactation potential of ewes and cows by optimal feeding with high legume pastures.

6. Aim to manage for increased clover on **at least** 10% of permanent pasture each year. Record paddock clover contents each spring to guide decisions on which paddocks need improvement.

7. It is difficult to optimally manage more than one clover species in a pasture. It may therefore be best in higher rainfall areas to manage for white clover on south faces and sub clover on sunny faces.

8. Allow annual clovers to fulfil their growth potential by rotationally grazing after a flock finishes lambing.

9. Select sub clover cultivars to match the time when the soil usually dries out and pasture ceases to grow.

Future proof your dryland farm against climate warming with annual clovers.

Dryland Pastures Research supporters

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The Sub 4 Spring research projects were also supported by Field Research Centre staff and post grad students at Lincoln University, and the farmers who hosted the experiments on their properties.

Sub clover 'Antas' at Mt Benger. Photo: Dick Lucas.