RADE Public Field day

Lincoln University

11 December 2025

Whenua Haumanu

"Nurturing the land through exploring pastoral farming"

Lincoln University's Dryland Pastures Research Group (www.drypandpastures.com) is conducting this experiment as the dryland component of the Massey University-led Whenua Haumanu programme (https://www.massey.ac.nz/about/colleges-schools-and-institutes/college-of-sciences/our-research/themes-and-research-strengths/whenua-haumanu/). Funded by the Ministry for Primary Industries (MPI). Whenua Haumanu is a partnership between Massey University and the MPI through the Sustainable Food and Fibre Futures fund. Programme delivery partners include Lincoln University, AgResearch, Manaaka Whenua and the Riddet Institute.

Table of Contents

Hazard summary – Field Research Centre managed research areas

By entering this experimental area, you are acknowledging your receipt of this hazard summary and your agreement to take personal responsibility to watch out for potential hazards and act in such a manner as to protect yourself and any others also on-site.

People

- Uninformed/ill-prepared/unauthorized visitors may be the greatest risk.
- Wear appropriate footwear and clothing for the conditions – including sunhats/sunscreen to prevent sunburn.
- Stay hydrated.
- Lincoln University has a strict no smoking/no vaping policy on campus.

Animals

- It is their space.
- They are not tame.
- Do not enter areas with stock present.
- Take no action which is likely to modify animal behaviour.
- No dogs are permitted on site.
- Leave all gates as you find them.

Potential slips/trips

- Uneven surfaces occur across the area.
- Rabbit burrows are present.
- Fences.
- Monitoring equipment within the paddocks (e.g. neutron probe access tubes).
- Toughs & salt lick blocks.

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

Research activities

- Avoid staff/students in the process of taking plant and animal measurements.
- Drones collect data here – the camera is operating. Do not enter the area within the operational windows without prior authorization.

Ears/Eyes

- Windblown seed/pollen/dust.
- Loud equipment/machinery.

Touch

- Treat electric fences as high voltage power sources.

Machinery, Tools & Vehicles

- Keep out of the road of all vehicles and farm equipment. Assume they can't see you.
- Tools and machinery generate noise/fragments. Maintain your distance.
- Authorised personnel only in the compound.
- Only authorised persons can operate machinery/vehicles/research equipment. Helmets must be worm if traveling in the mule.

- **Research activities and measurements take priority over all other on-site activities/access.**
- **ARE YOU TRAINED FOR WHAT YOU ARE ABOUT TO DO? If not, STOP.**
- **If you are uncertain how you should act or proceed, stop and contact the farm manager, other farm staff or your host.**

Programme

Stop 1: Housekeeping and Intro
General introduction to the Regenerative Agriculture Dryland Experiment including housekeeping for the field day. (DJM)

Stop 2: Yield & Composition
Measurements being taken in Regenerative pastures (yield, composition, species in mixes). (ADB)

Stop 3: Soil
Soil P, Microbial biomass, P intake, P dung returns (KW)
Lucerne yield responses to P (LJ)

Stop 4: Soil water and Grazing management
Soil moisture (JN)
Lucerne grazing management (DJM)

Stop 5: Grass-based pastures
Cocksfoot/subterranean clover and pasture conservation (ADB).

Stop 6: Ecosystem carbon balance
Measurements for net ecosystem carbon balance (BH)

Stop 7: Animal production
Annual LWt production and mean daily growth rates (LR)

Stop 8: Pasture quality
Pasture quality (OI)
Wrap up and questions (DJM)

Refer to Figure 1 for location of stops.

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

Welcome to the Regenerative Agriculture Dryland Experiment

- The RADE is an 8-ha farmlet that aims to investigate the total-farm impacts of regenerative agriculture (RA) practices versus conventional best practices for dryland sheep production.
- The two systems are replicated across soils of two phosphorus (P) fertility levels to determine their ability to operate with less P fertiliser.
- The experiment in currently in its 4th growth season (2025/26).

Design

- The experiment is a 2 × 2 factorial of regenerative (R) and conventional (C) practices and high (H) and low (L) soil P fertility (Olsen P 20-25 and 10-15).
- **Regenerative practice:** a system of diverse pastures and winter crops, rotational grazing with sheep at high stock densities and frequent shifts (2–3 days) and no herbicide.
- **Conventional practice:** a system of lucerne and cocksfoot/sub clover pastures and autumn-sown rape or annual ryegrass for the winter crop, rotational grazing with sheep at lower stock densities and less frequent shifts, and herbicide where required.
- The treatments are laid out in five 4 × 4 Latin squares (Figure 1), to allow for effects of existing paddock, soil depth and hedges.
- Treatments are randomised with the restriction that each treatment occurs once in each row and once in each column of each Latin square.
- Plot size is average 0.1 ha and range 0.087–0.132 ha.
- Twenty plots of the same treatment make up four autonomous farms of 1.936 ha.

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

Figure 1 Latin square design with five 4 × 4 Latin squares of regenerative (R) and conventional (C) × high (H) and low (L) soil fertility treatments. Square 1 is Plots 1–17, Square 2 is 18–32, Square 3 is 33–48, Square 4 is 49–64 and Square 5 is 65–80. Red stars indicate today's field stops.

Forage types

Regenerative:

- **<u>Diverse with lucerne</u>:** 5 kg/ha 'Jeronimo' prairie grass, 1 kg/ha 'Choice' chicory , 0.5 kg/ha 'Safin' cocksfoot, 4 kg/ha 'Hummer' tall fescue, 4 kg/ha 'Oakdon' meadow fescue, 6 kg/ha of either 'Kaituna' (Square 1) or 'Takahē' (Square 2) lucerne, 0.3 kg/ha 'Maté' phalaris, 2 kg/ha 'WGB23587' timothy, 0.5 kg/ha 'Captain' plantain, 1 kg/ha 'Amigain' red clover, 0.3 kg/ha 'Legacy' white clover and 1 kg/ha 'Woogenellup' subterranean (sub) clover **(12 species)**.
- **<u>Diverse without lucerne</u>**: same as above with lucerne replaced by 1 kg/ha 'Taipan' balansa clover **(12 species)**.
- **<u>Annual crop</u>:** 0.8 kg/ha 'Titan' rape, 0.5 kg/ha 'York Globe' turnip, 1 kg/ha 'Pasja' leafy turnip, 5 kg/ha 'Devour' annual ryegrass, 1 kg/ha phacelia, 1 kg/ha 'Captain' plantain, 1.3 kg/ha 'Taipan' balansa clover and 1.3 kg/ha 'Lightning' Persian clover **(eight species)**.

Conventional:

- **<u>Lucerne</u>:** 15 kg/ha of either 'Kaituna' (Square 1) or 'Takahē' (Square 2) lucerne.
- **<u>Cocksfoot/sub clover</u>:** 4 kg/ha 'Greenly II' cocksfoot, 10 kg/ha 'Denmark' and 10 kg/ha 'Narrikup' subterranean clover.
- **<u>Annual crop</u>:** 4 kg/ha 'Titan' rape in Year 1 and 25 kg/ha 'Devour' annual ryegrass in each subsequent year.

- 'Diverse with lucerne' and lucerne pastures are compared in Squares 1, 2 and 4 (12 plots/farm), 'diverse without lucerne' versus cocksfoot/sub clover in Squares 3 and 5 (eight plots/farm) and diverse versus rape or annual ryegrass winter crops in two rows per annum in a pasture-crop-pasture rotation (two plots/farm).
- Established over 16 months as land became available: Squares 1 and 2 in December 2021, Square 3 in March 2022, Square 4 in October 2022 and Square 5 in March 2023.

Sheep

Years 1-2 (2021-23)

- Coopworth old ewes and ewe lambs-hoggets grazed during establishment phase (Feb. 2022 to Aug. 2023).

Years 3-5 (2023-26)

- 80 mature, in-lamb Bohepe ewes were allocated to the farms on 1–30 August 2023 (https://rdbeattie.co.nz/bohepe).
- 20 shorn Bohepe hoggets were introduced on 24 January 2024.
- Lambs are born from mid-August to mid-September and weaned early December each year.
- From weaning, terminal (Bohepe and Bohepe x Suffolk) lambs >35 kg are sold as 'prime' to a local meat factory in December-February.
- Terminal lambs <36 kg are removed as 'stores' in December-February.
- Maternal (Bohepe) lambs are retained for breeding: 4-6 ewe lambs/farm and 0-2 ram lambs/farm each year.
- The ewes are shorn in December and maternal lambs in March.
- In March-April 2024, the ewes and hoggets were mated with the Bohepe rams and then terminal South Suffolk rams.
- In March-April 2025, ewes, hoggets and ewe lambs were mated with Bohepe, then Suffolk and then Bohepe rams.
- Ewe stocking rate is adjusted annually – currently 14.5 ewes/ha on each farm (24 mature ewes and 4 hoggets/farm) (Figure 16).
- Conventional flocks are divided evenly into two mobs/farm to create the low stock density and shift-frequency treatment.

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

Fertiliser inputs

Table 1 Mean fertiliser input for regenerative (R) and conventional (C) x high (H) and low (L) soil fertility farms.

Year	Farm	P (kg/ha)	S (kg/ha)	N (kg/ha)	Lime (kg/ha)
2021-22	HR	33	54	0	1,438
	HC	30	51	3*	1,438
	LR	1	4	0	1,438
	LC	5	8	3*	1,438
2022-23	HR	10	12	0	0
	HC	11	13	0	0
	LR	2	5	0	0
	LC	2	5	0	0
2023-24	HR	41	150	0	0
	HC	41	150	0	0
	LR	1	101	0	0
	LC	2	101	0	0
2024-25	HR	19**	18	0	0
	HC	18	40	0	0
	LR	0	18	0	0
	LC	0	18	0	0
2025-26	HR	0	0	0	0
	HC	0	0	0	0
	LR	0	0	0	0
	LC	0	0	0	0

*N fertiliser applied to one crop of winter rape/farm.
**P fertiliser was RPR for Regenerative and Superphosphate for Conventional in 2024-25.

Table 2 Mean soil pH, Olsen P and sulphate S in the top 0–75 mm of the soil for regenerative (R) and conventional (C) x high (H) and low (L) soil fertility farms.

Date	Farm	pH	Olsen P (mg/kg)	Sulphate S (mg/kg)
25/08/2023	HR	6.4	14	5
	HC	6.4	15	5
	LR	6.4	13	3
	LC	6.4	13	4
11/07/2024	HR	-	22	-
	HC	-	21	-
	LR	-	14	-
	LC	-	14	-
10/07/2025	HR	6.1	24	20
	HC	6.5	25	19
	LR	6.2	16	17
	LC	5.9	15	11

Yield and botanical composition

Herbage mass (Figure 2) and its botanical composition (Figure 4) are measured before and after each plot is grazed, topped, cut for hay, or tilled, for each harvested plot, and once a month for all 80 plots. Yield is calculated as the change in herbage mass between defoliations (Figure 3).

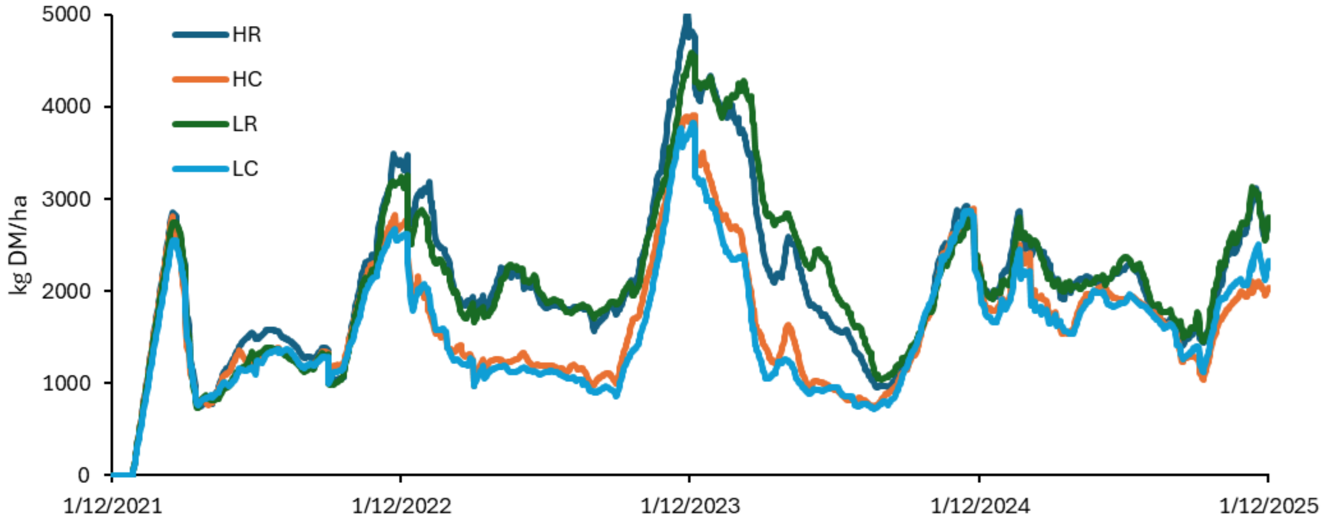


Figure 2 Average herbage dry matter (DM) mass (‘average farm cover’) for the regenerative (R) and conventional (C) x high (H) and low (L) soil fertility farms.

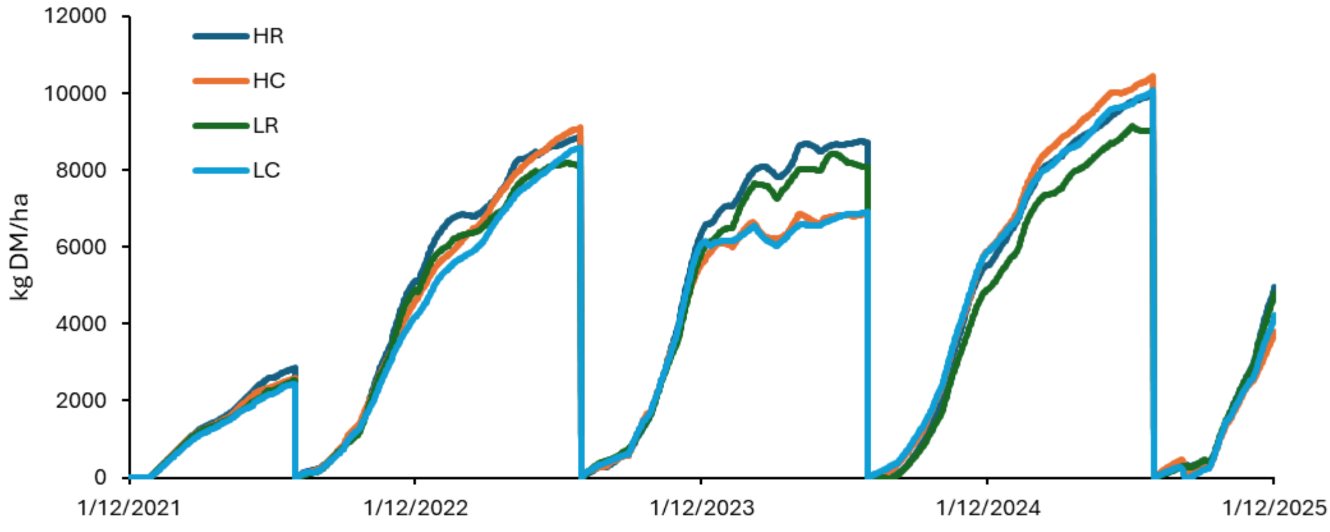


Figure 3 Average herbage dry matter (DM) yield for the regenerative (R) and conventional (C) x high (H) and low (L) soil fertility farms.

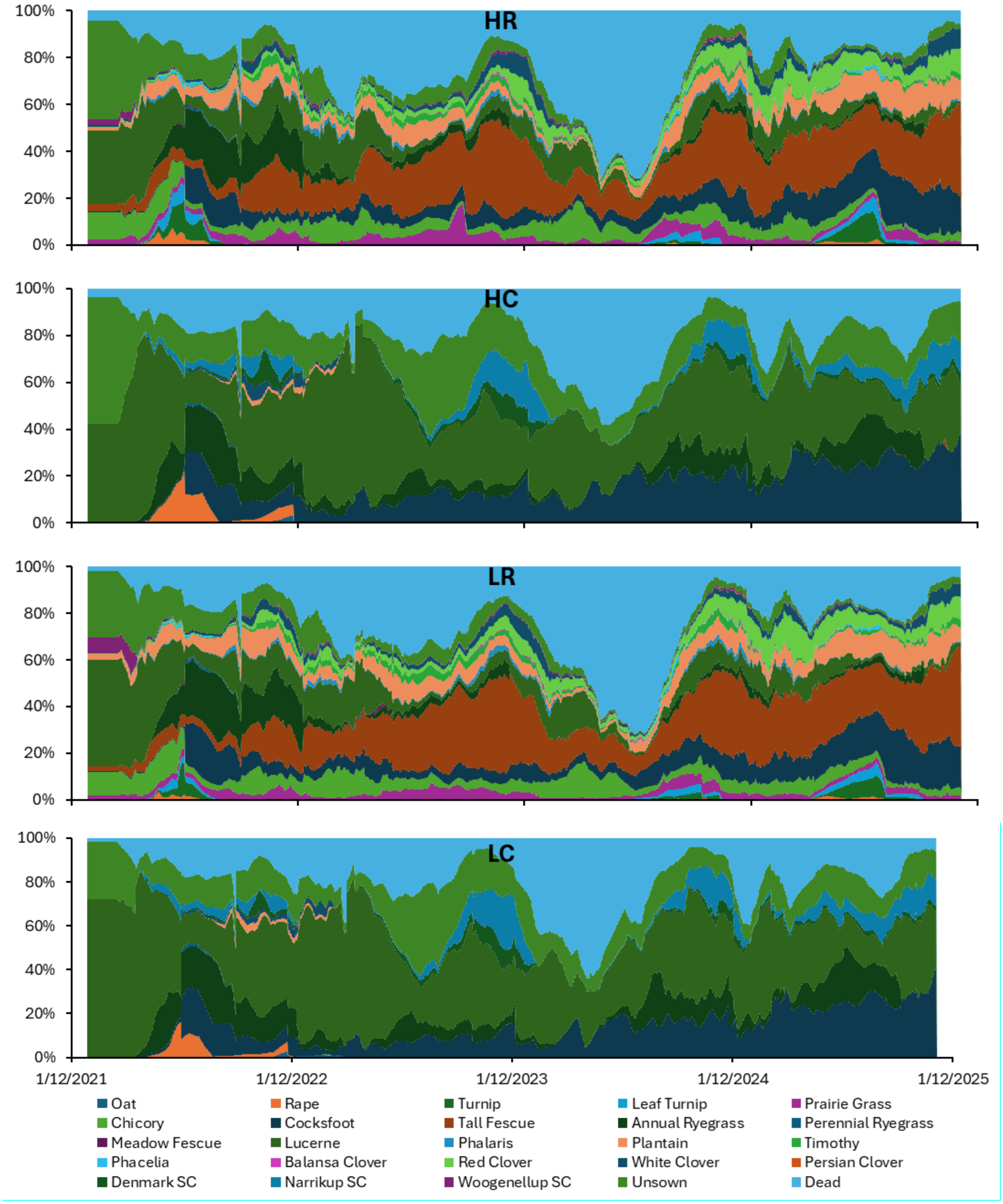


Figure 4 Average botanical composition for the regenerative (R) and conventional (C) x high (H) and low (L) soil fertility farms.

Soil fertility – What's happening with phosphorus?

Kaitlin Watson – PhD student (Soils)

Phosphorus key findings:

- Three plant-available P measurements were used to detect differences in the most labile soil P pool, and each extracted increasing amounts of P from the soil in the order Mehlich P > Resin P > Olsen P (Figure 5). These three tests were examples of acid, neutral, and alkaline extractions. The only system difference in soil labile P was in spring 2024, with high fertility conventional P higher than high fertility regenerative, likely due to RPR being applied instead of SSP.

- Microbial biomass P (Figure 7a) and acid phosphatase activity (Figure 7b) peaked in autumn 2025 across all treatments, indicating strong seasonal controls on soil biological P processes.

- Herbage P concentrations were on average higher in the conventional (0.30%) than regenerative treatments (0.27%) ($P = 0.01$) and in high-fertility (0.31%) than low-fertility treatments (0.27%) ($P < 0.01$), with temporal variation strongly positively associated with soil moisture.

- Differences in animal P intake due to treatment were only observed in the summers and autumns (Figure 8). In summer 2023, autumn 2023, and 2025, the intake was higher for the conventional treatments than for the regenerative treatments by 6.1, 1.9, and 2.2 kg P ha^{-1}, respectively. Fertility differences were observed in summer 2023 and 2024, where intake was 0.9 and 2.1 kg P ha^{-1} higher in the high fertility than the low fertility.

- Dung P returns (Figure 9) were higher in the conventional than the regenerative in the first two years (by 7 and 4 kg P ha^{-1} in Year 1 and Year 2, respectively), but higher in the regenerative in Year 3 (by 3 kg P ha^{-1}). A soil fertility effect on dung P emerged only in Year 3, favouring high-fertility treatments (+6 kg P ha^{-1}).

- Overall, regenerative management supported increased P recycling over time (dung P returns), but at lower soil and plant P concentrations than in conventional lucerne pastures.

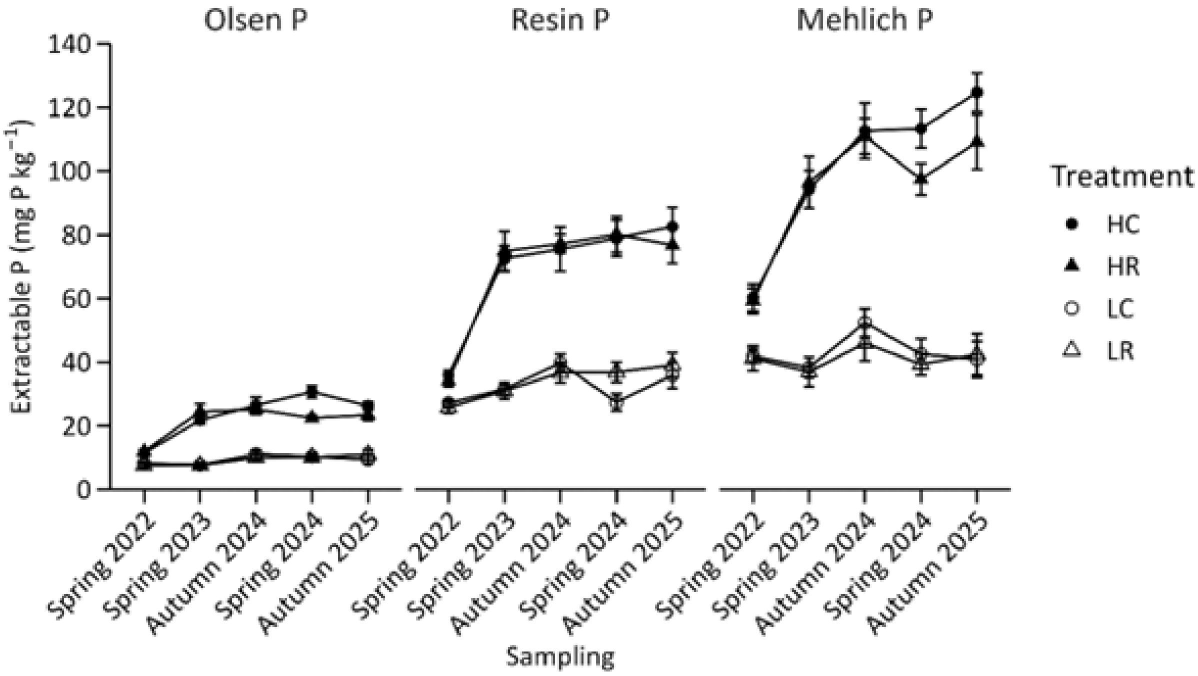


Figure 5 Average Olsen P, Resin P and Mehlich P (mg P kg^{-1}) each season for high fertility conventional (HC; ●), high fertility regenerative (HR; ▲), low fertility conventional (LC; ○) and low fertility regenerative (LR; △) treatments. Values are means ± 1 standard error (n = 7 or 8). Targets are usually 20, 40 and 50 mg P kg^{-1} for Olsen P, Resin P and Mehlich P, respectively.

Figure 6 (right) Plating of enzyme substrates for analysis and (left) Mehlich P analysis using Murphy Riley colourimetry procedure. Bluer = more phosphorus.

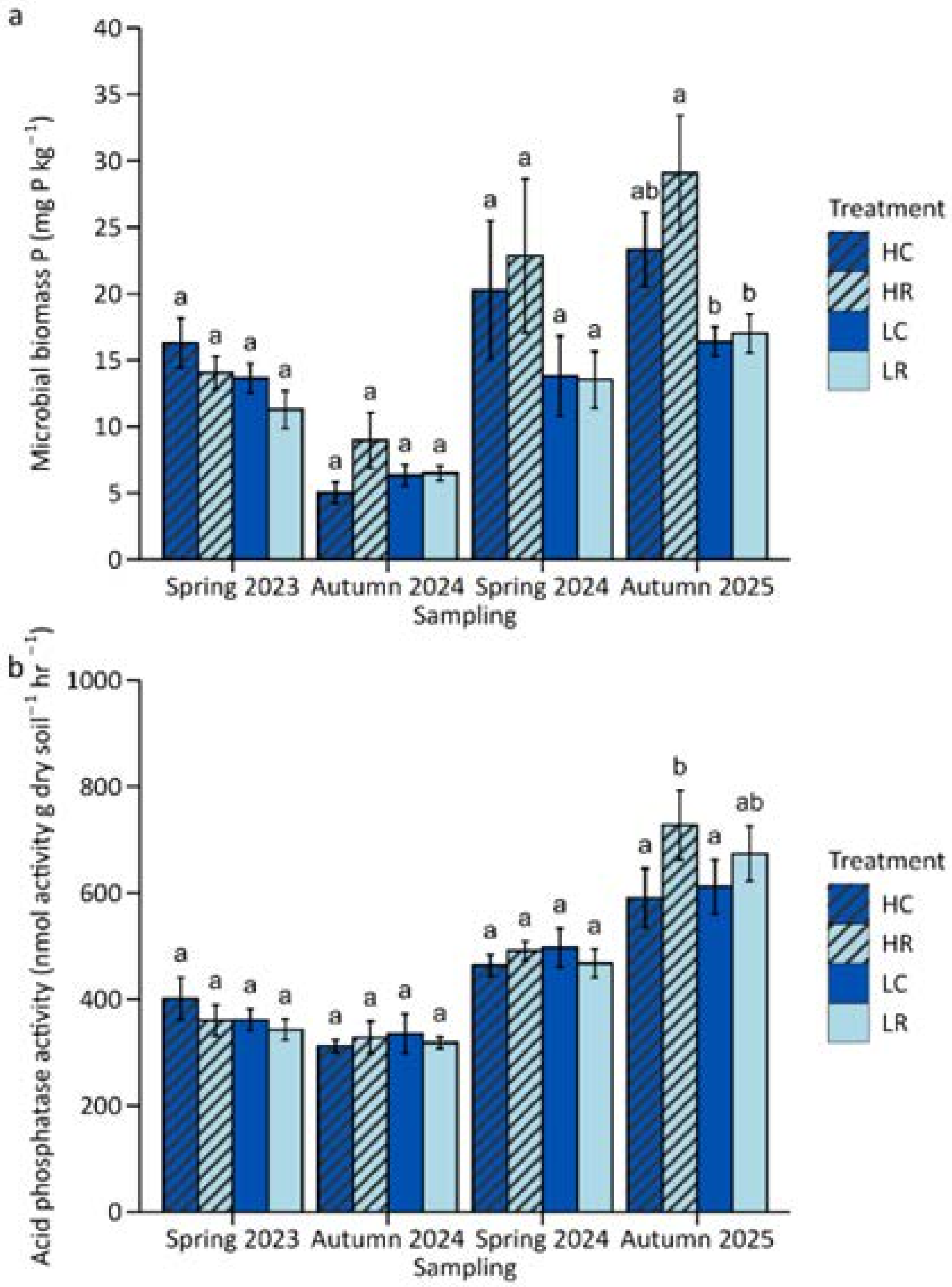


Figure 7 Soil (a) microbial biomass P (mg P kg^{-1}) and (b) phosphatase activity (nmol activity g dry $soil^{-1}$ hr^{-1}). Treatments were high-fertility regenerative (HR), high-fertility conventional (HC), low-fertility regenerative (LR), and low-fertility conventional (LC), represented by the coloured bars. Values are means ± 1 standard error (n = 7 or 8). Bars that share the same letters are statistically the same (P>0.05) within each season.

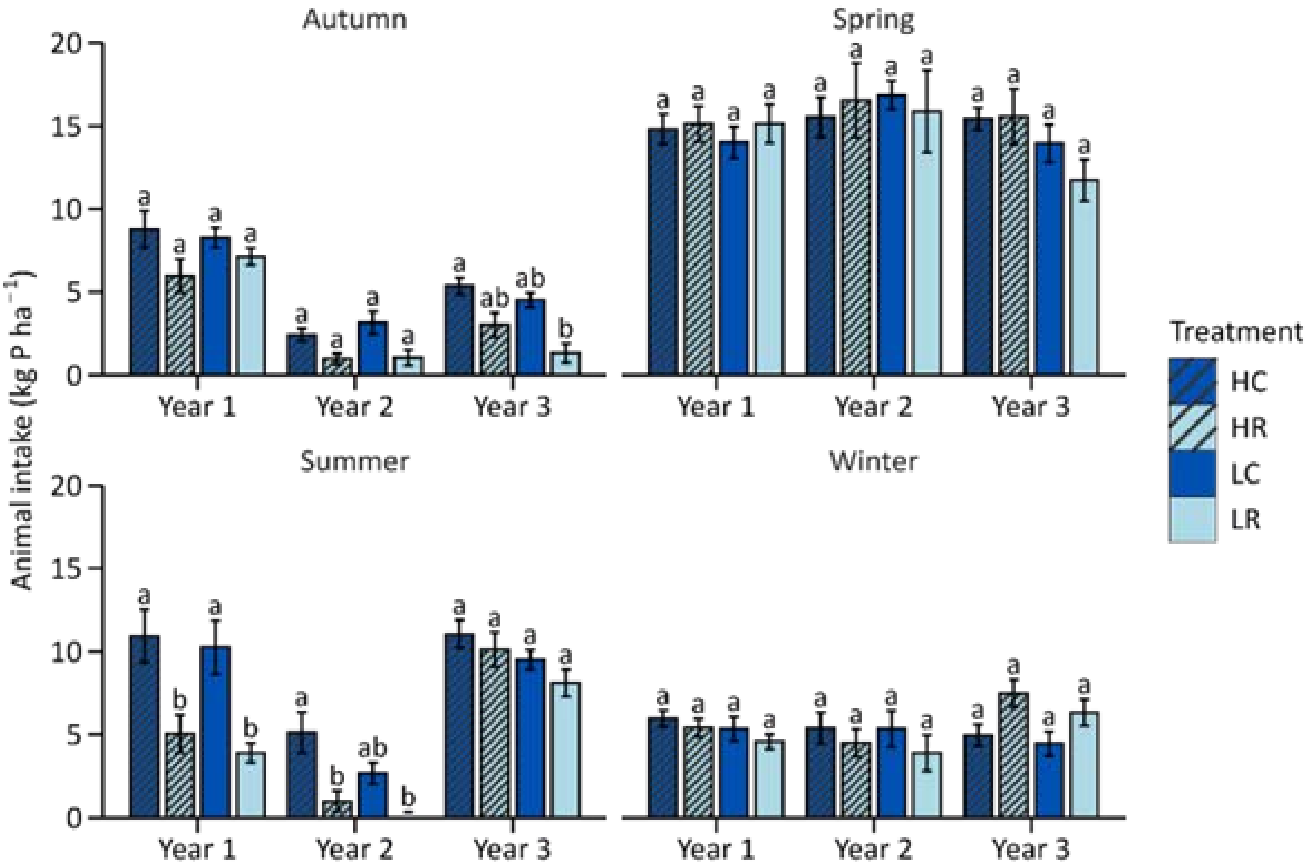


Figure 8 Mean animal plant P intake (kg P ha^{-1}) per season for high fertility regenerative (HR), high fertility conventional (HC), low fertility regenerative (LR) and low fertility conventional (LC) treatments, represented by dark blue for conventional and light blue for regenerative and stripes for high fertility and none for low fertility. Values are means ± 1 standard error (n = 7 or 8). Bars that share the same letters are statistically the same (P>0.05) within each season.

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

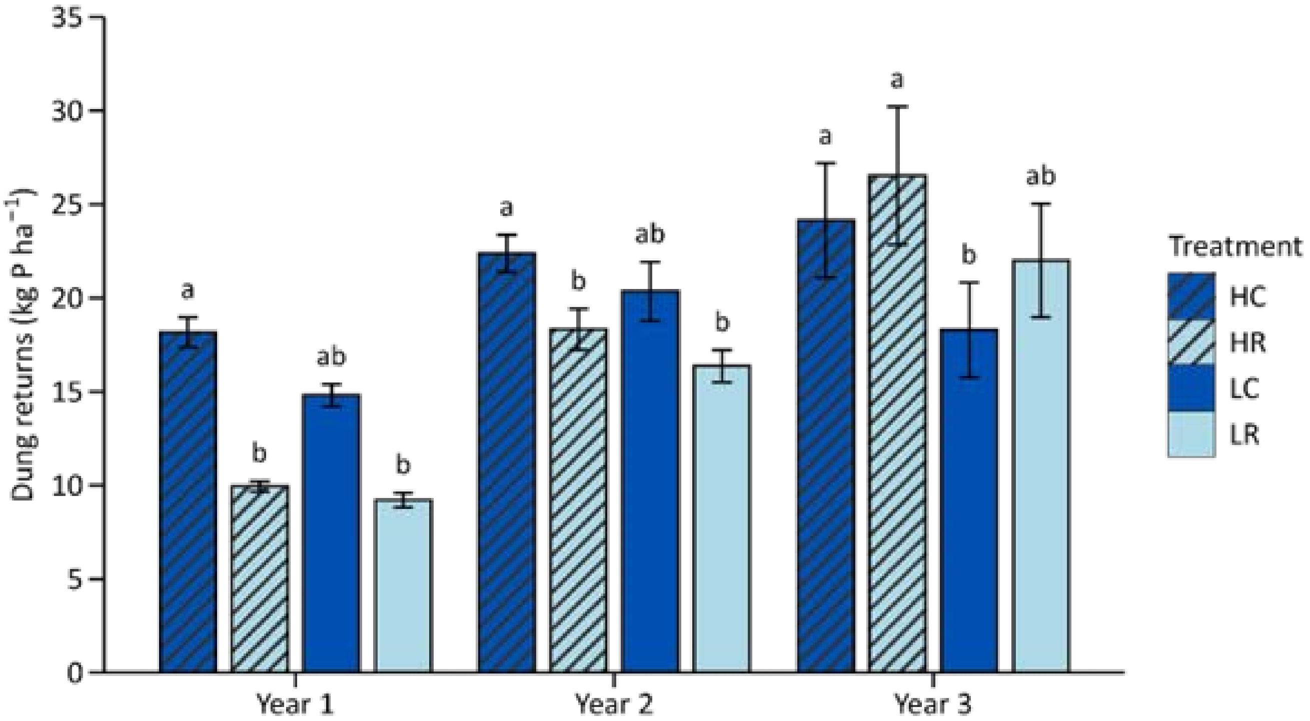


Figure 9 Dung P returns (kg P ha^{-1}) in each year for high fertility regenerative (HR), high fertility conventional (HC), low fertility regenerative (LR) and low fertility conventional (LC) treatments, represented by the coloured lines. Values are means ± 1 standard error (n = 7 or 8). Bars that share the same letter are statistically the same (P>0.05) within each year.

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

Lucerne yields under different phosphorus fertility levels

Lauren Jones– PhD student (Plants)

RADE

- No relationship between soil Olsen P (7.5 cm) and annual lucerne yields in the 23/24 and 24/25 seasons (Figure 10).

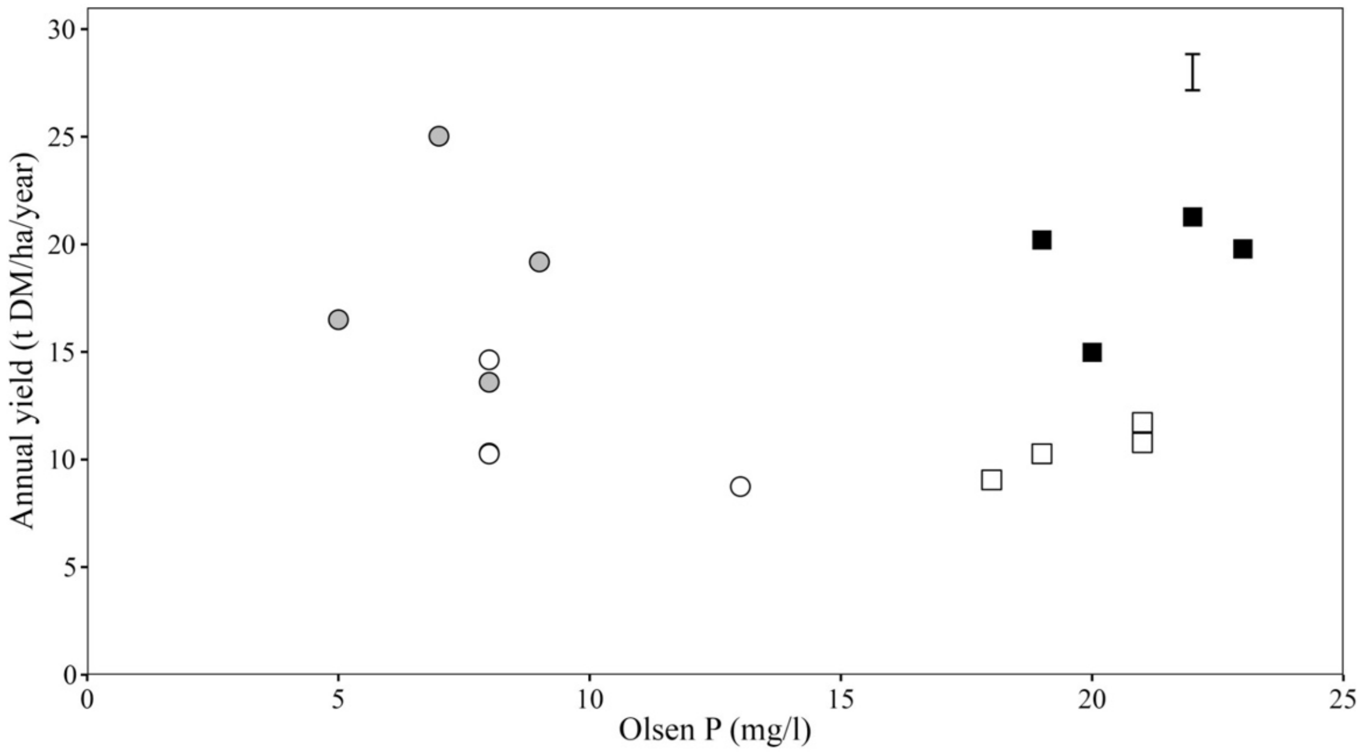


Figure 10 Total annual accumulated lucerne shoot yield (kg DM/ha/yr) against soil Olsen P (mg/l) under high (■, □) or low (●, ○) phosphorus fertility levels. The closed symbols are for Year 2 and the open symbols are for Year 3. The vertical bars are the pooled SEM.

Iversen 5

- No difference in annual lucerne yields across four growing seasons among superphosphate application rate treatments (Figure 11).

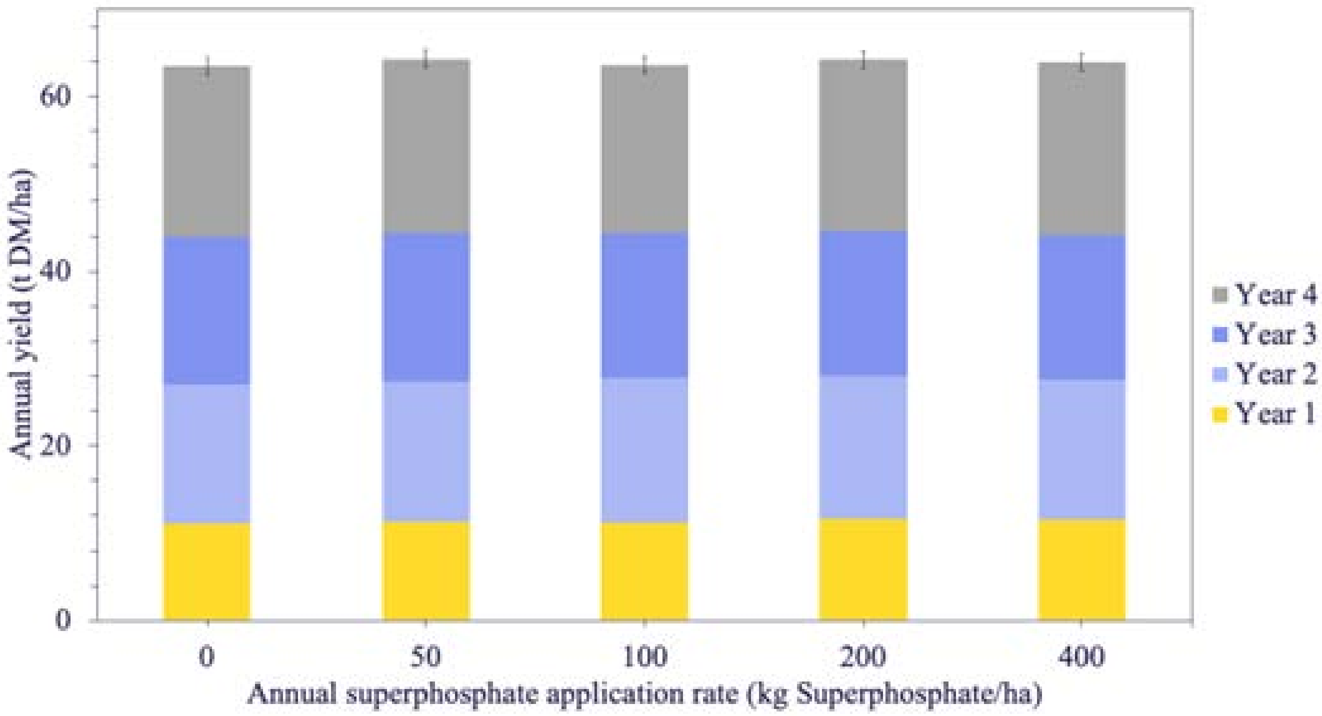


Figure 11 Total annual accumulated lucerne shoot yield (kg DM/ha/yr) against superphosphate application rates (kg/ha). The vertical bars are the SEM.

Lucerne: Agronomy

Prepared by Prof. Derrick Moot Lincoln University.
Derrick.Moot@lincoln.ac.nz

Establishment

- pH>6.0 – soil test
- 5-7 kg/ha of inoculated bare seed equivalent
- Allow 50% flowering in spring establishment crop
- Free draining soil
- Modern cultivars are pest resistant

Weed control

- Graze at 20 cm if weedy – then allow flowering
- Early- mid winter control of annual and perennial weeds
- Paraquat burns leaves so early control essential

Fertiliser

- Hungry for nutrients if always conserved (e.g. 20 kg K/ha/t DM removed)
- Use potassic based fertilizer
- Nitrogen not required

Animal health

- Na is stored in roots so may be deficient for animals, use salt.
- Bloat on high quality feed - fibre available especially for lush feed
- Red gut – rapid passage of high quality feed – watch early spring
- Offer e.g. meadow hay to reduce possibility of red gut or mow
- Flushing in dry years – avoid lucerne with leaf spots
- If in doubt – 2 weeks off lucerne before ram goes out

Conservation

- Leaf is the high-quality component
- Bale with dew
- Silage should be wilted and may need an inoculant
- Spring crop is heaviest and vegetative (but why bale it?)

Irrigation

- Minimal at establishment (encourage root growth)
- 10-14 days after grazing (no leaf = no demand) big drinks 40-60 mm
- Encourages weed seed germination – so wait for leaf
- Sitting water rots root

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

Lucerne: Grazing management for production and persistence

Prepared by Prof. Derrick Moot Lincoln University.
Derrick.Moot@lincoln.ac.nz

Autumn recovery (Feb/Mar)

- Allow >50% of stems with an open flower to encourage root recharge
- Graze if terminal drought but then allow recovery after rainfall until growth stops.

Winter weeds (June/July)

- Hard graze with large mob once frosts stops growth
- Apply weed control 14 days later
- Node accumulation on stems sets up spring potential
- Late spray or early 'green pick' drastically delays spring growth and reduces yield

Spring production (Sept/Oct/Nov)

- Begin grazing with ewes and lambs at crop height ~10 cm (1000 kg/ha)
- 3-10 day break e.g. 14 ewes + lambs/ha (over 20 ha = 280 mob)
- 5-6 paddock rotation (30-40 days recovery) – aim for 30 cm on re-entry
- Salt the chips – lucerne is low in foliar sodium so offer salt licks!
- Post weaning - Lambs only eat lucerne leaf– 70/ha? Ewes follow
- 2.5-4.0 kg DM/hd allowance
- Minimum of 6-8 weeks on lucerne to maximize LWG
- High quality leaf (ME >12, protein >24%)
- Low quality stem (ME~8, protein <14%)
- Graze before flowering
- Delayed harvest increases proportion of stem

Summer holiday (Dec/Jan)

- Go fishing
- Early flowering – low thermal time target and warm temperatures
- Shorter rotation 30-35 day return -low yields
- Water stress accelerates flowering but leaf is still high quality
- Conserve a true surplus

Soil water

Method:

- Measured by TDR (0-0.2 m in plots 1-16 and 0-0.5 m in plots 17-80) and neutron probe at 0.1 m intervals (to 2.3 m depth (plots 1-16).
- This means that there are 23 readings plot in plots 1-16.
- Each 0.1 m layer stores soil water – like a series of buckets.
- Regular monitoring allows us to observe when the pastures start extracting water from different layers in the profile over time.

What is shows:

- In Canterbury potential evapotranspiration (PET) exceeds rainfall from September to April in most years.
- Potential evapotranspiration is a measure of atmospherically driven water demand by an actively growing crop/pasture with full canopy cover.
- In a dryland (rainfed) system when water supply from rainfall falls below atmospherically driven demand soil deficits develop. This is the period when roots extract soil moisture stored in the soil to allow growth to continue.
- Figure 12 shows how the soil profile (0-2.3 m) dries as water is extracted from Summer 2021. A reading of zero means the soil is at field capacity (all soil layers are full).
- Winter rainfall in 2025 did not fully recharge the soil to field capacity – effectively we started the 2025/26 growth season with a small deficit (although not as severe as for the 2024/25 growth season).
- Figure 13 shows the soil moisture content in early December in 2022, 2023, 2024 and 2025 for Plots 13/16 relative to the upper (DUL) and lower (LL) water holding capacity in each soil layer.

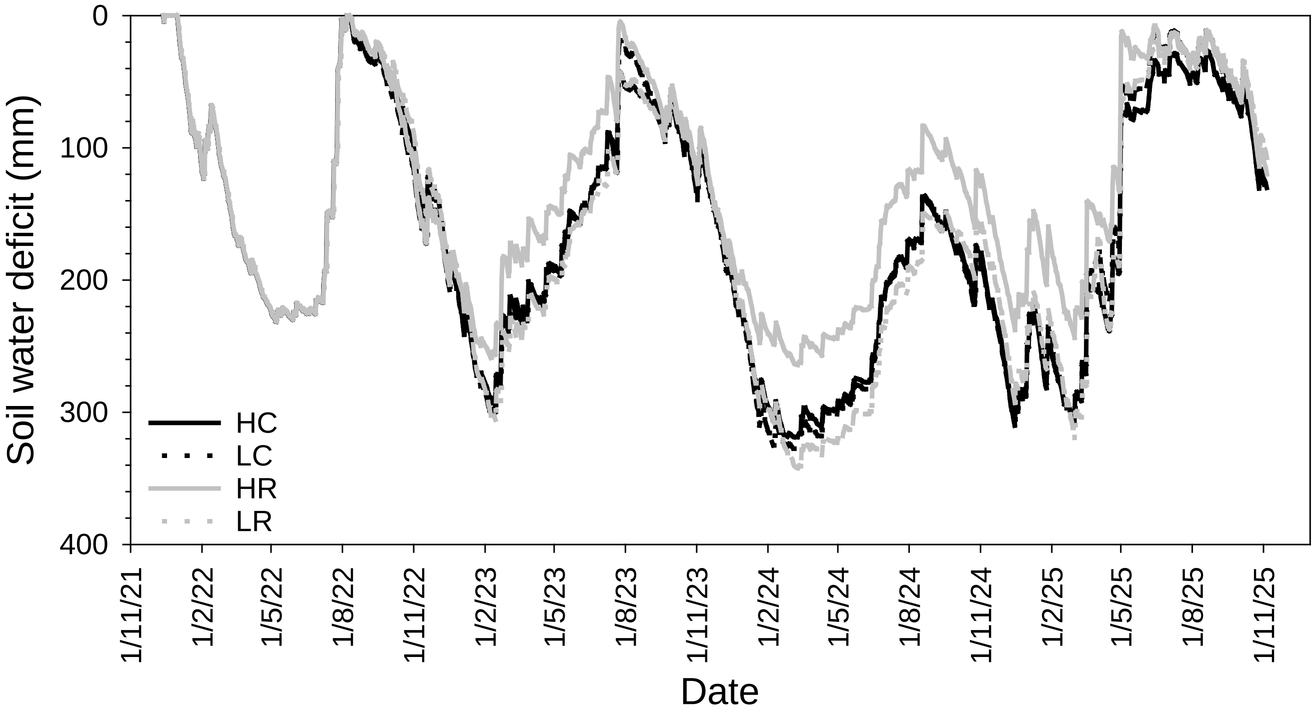


Figure 12 Soil water deficit of four pasture treatments at the RADE experiment at Lincoln University from summer 2021. Treatment means are calculated across all 80 plots. (updated to Nov 2025).

Figure 13:

- The area to the left of the dotted LL line is not available for growth – physically the plants cannot extract this water.
- The solid black line (DUL) on the right is how much water can be held in each soil layer when at field capacity (“full”).
- The difference between DUL and LL is the amount of water the plants can access for growth in addition to rain that falls within the growth season.
- On 3 December this year the pastures had 150-250 mm of plant available water remained in the profile. If PET averages 5 mm/d, and we assume growth continues at the maximum rate, we will run out of water in about 30-50 days.
- In practice, soil water becomes harder to extract as the soil dries, less water than potential is extracted and growth slows, then ceases.

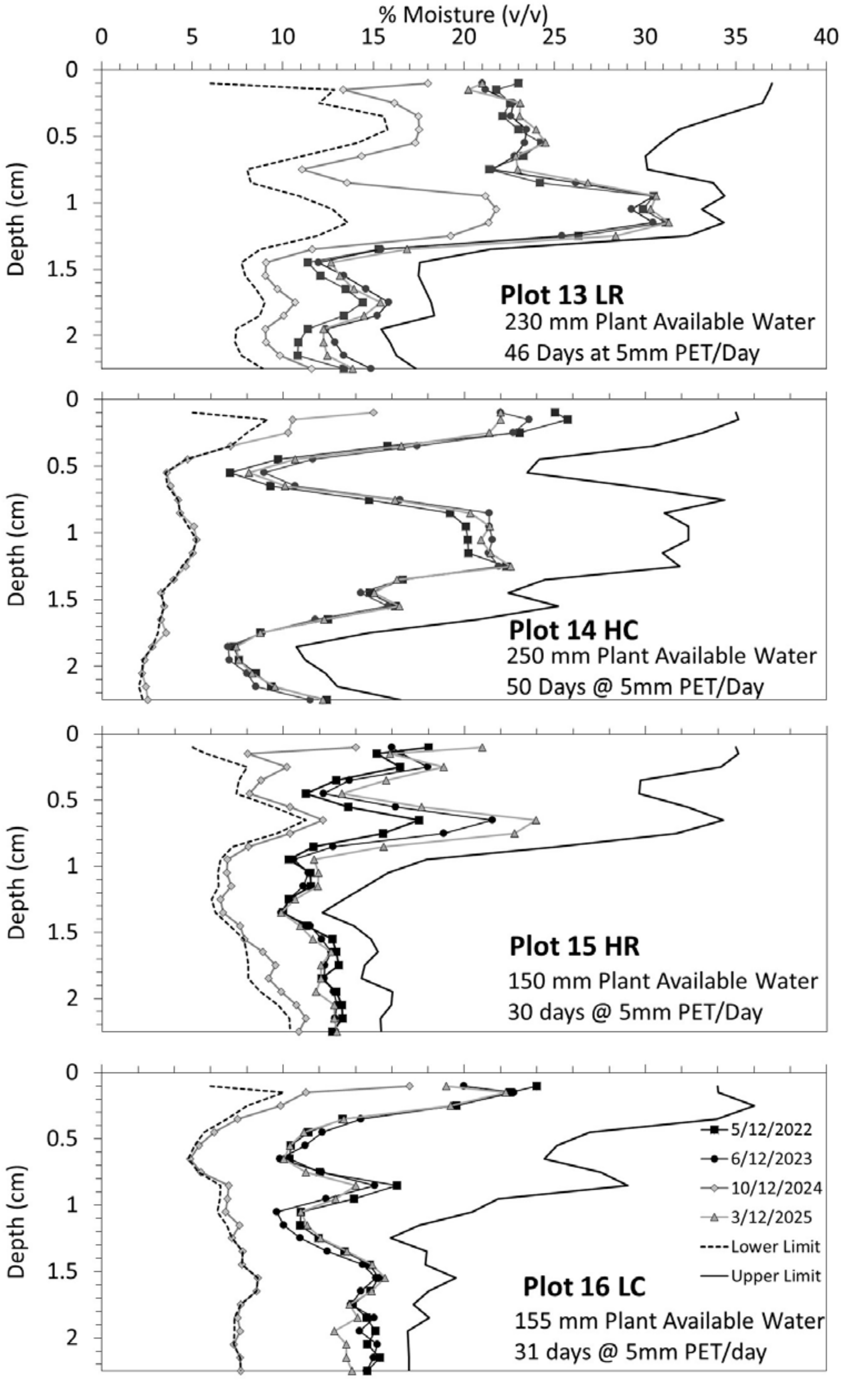


Figure 13 Early December soil water content (mm) in 23 soil layers (0-2.3 m) in Plots 13-16 over four years (2022-2025).

drylandpastures.com

Whenua Haumanu

Nurturing the land through exploring pastoral farming

Sub clover management

Table 3 Subterranean clover grazing management regime (Olykan *et al*. 2019).

Month	Grazing management
Jan–Feb	Beef cows intensively graze last of mature reproductive grass down to 600 kg DM/ha pasture cover. May use electric wires to pressure stock to avoid patch grazing.
Feb–Mar	Look for sub clover germinating after early autumn rain and spell until seedlings have 3–4 trifoliate leaves.
Apr–Jun	When required, use a mob of 100 hoggets/ha to control grass cover down to 50 mm for 1 to 2 days
Jul–Aug	Set stocked ewes with twins at 6/ha from late July with 1.5 heifers/ha
Sep	From late September, as sub clover starts to flower, take ewes and lambs off to legume-dominant lowland paddocks. Leave 1.5 heifers/cows/ha in the block during Oct.
Oct	If sufficient sub clover exists after weaning lambs on 1 Oct, put in 250 weaned lambs (~20/ha) to graze down to 1200 kg DM/ha.
Nov–Dec	No stock until end of December to allow sub runners to spread and set seed.
Late Dec	Depending on feed quality, run hoggets or ewes through first. Then graze cattle, e.g. trade heifers, to clean-up the mature grass and graze as seasonal rainfall allows.

Reference:

Olykan ST, Lucas RJ, Nicholson DJ, Doscher C, Moot DJ. 2019. Maximising the subterranean clover content on a summer-dry Wairarapa hill-country farm through grazing management. *Journal of New Zealand Grasslands 81*: 91-100. https://doi.org/10.33584/jnzg.2019.81.391.

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

Net Ecosystem Carbon Balance

Breanna Holt – PhD student (Plants)

Net ecosystem carbon balance (NECB) is the measurement of CO_2 in and out of a system, i.e. pasture systems (Figure 14). On the RADE this is measured pre-grazing and monthly with biomass measurements.

- **Purpose:** NECB can be used to predict the direction soil carbon will take by modelling the flux of carbon over time. The method accounts for air and soil temperature, soil moisture, PAR (measured at full light, ~30% shade, ~60% shade and dark) to model daily and annual carbon flux. The flux trend infers if more C over time is being stored within the soil or unharvested parts of the biomass than released via plant or soil respiration.

- **How:** The chamber (Figure 15) measures photosynthetic CO_2 uptake in full light, and when dark the full ecosystem respiration, shading infers cloud cover etc. While the PVC rings (~ 4 cm deep) exclude leaves and measure root and microbial respiration. Which allows for components of respiration to be separated.

- **So what?:** Physical soil C is highly variable and detecting changes takes many years (~6-10 years), NECB allows the prediction of how a system will effect soil carbon without waiting years to see that result in physical carbon.

- **What else am I measuring**: baseline C and N stocks to 60 cm (standard depth used for forest C/N stocks), pasture biomass/composition, pasture NDVI (greenness), potentially root mass. Which can be used to help determine the fate and rate of carbon within the system.

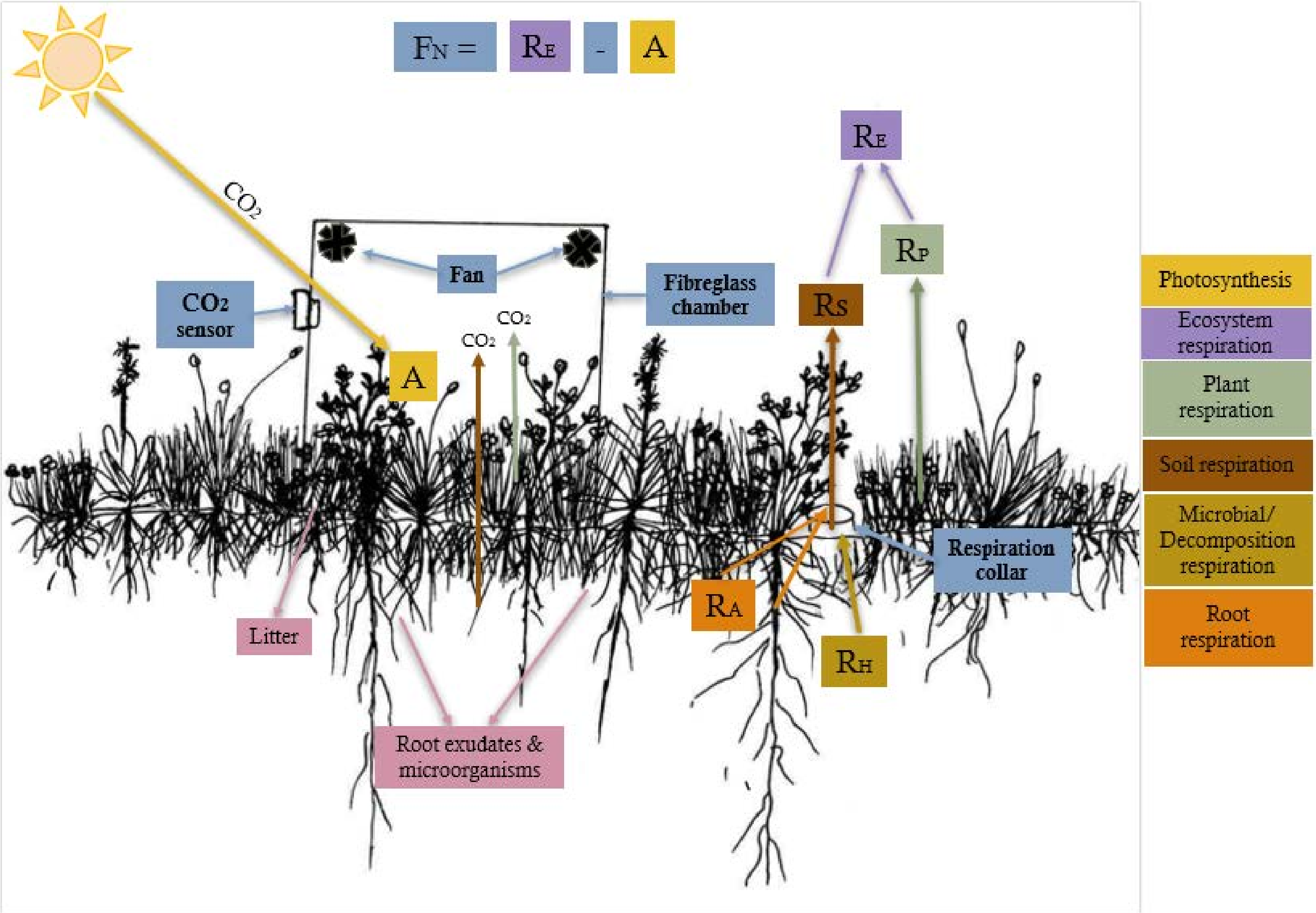


Figure 14 What information is needed to calculate a net ecosystem carbon balance (NECB)?

Figure 15 Field measurement

Stocking rate

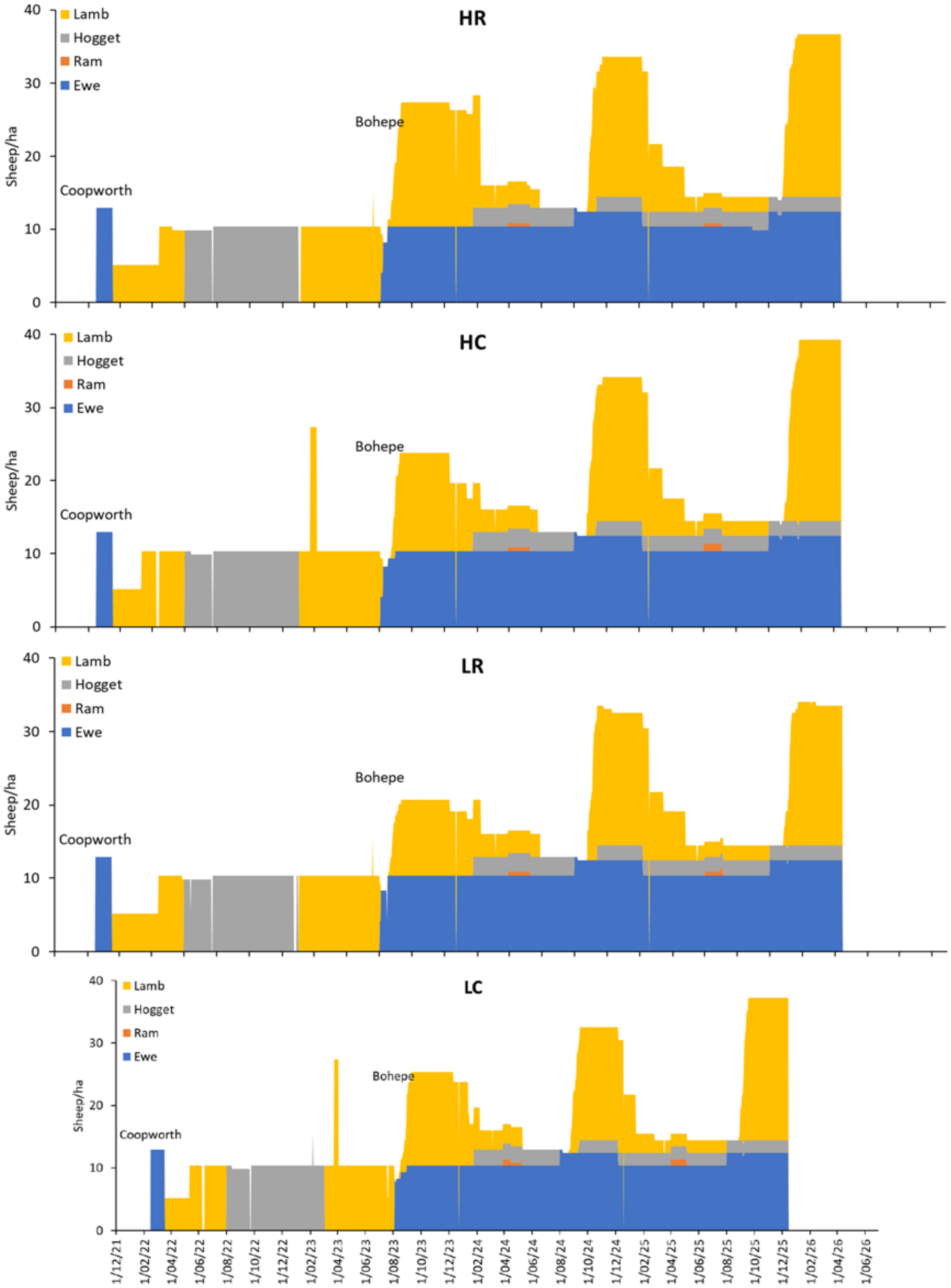


Figure 16 Stocking rate of regenerative (R) and conventional (C) x high (H) and low (L) soil fertility farms.

Animal production

Luke Robb – PhD student (Plants/Animals)

All sheep are weighed at about monthly intervals to calculate liveweight gain per head per day and liveweight production from each farm.

Summary:

- **Year 3:** 131 kg LWt/ha less production off RA, compared with CA (Table 4). Differences come from replacement ewe lambs, and prime lambs.
- **Year 4:** 134 kg LWt/ha less production off RA, compared with CA. Differences come from ewes, and store lambs.
- 2025 lambs grewat an average 280 g/hd/d in October, and 235 g/hd/d in November (Figure 17). Post-weaning growth rates will determine any differences in production between the farmlets.
- Pasture quality and timing of feed supply are the key factors influencing animal production.

Table 4 Annual farm production (kg LWt/ha), from regenerative and conventional farmlets from Year 3 (2023/24), and Year 4 (2024/25).

2023/24	Regenerative	Conventional	Difference
Stock Class			
Mature ewes	62	46	16
Hoggets	-3	-7	4
Maternal ewe lambs	110	219	-109
Maternal ram lambs	14	45	-31
Prime lambs	160	314	-154
Store lambs	153	10	143
Total	**496**	**627**	**-131**
2024/25	**Regenerative**	**Conventional**	**Difference**
Stock Class			
Mature ewes	94	154	-60
Hoggets	45	41	4
Maternal ewe lambs	116	117	-6
Maternal ram lambs	13	8	5
Prime lambs	230	255	-25
Store lambs	162	218	-55
Total	**651**	**785**	**-134**

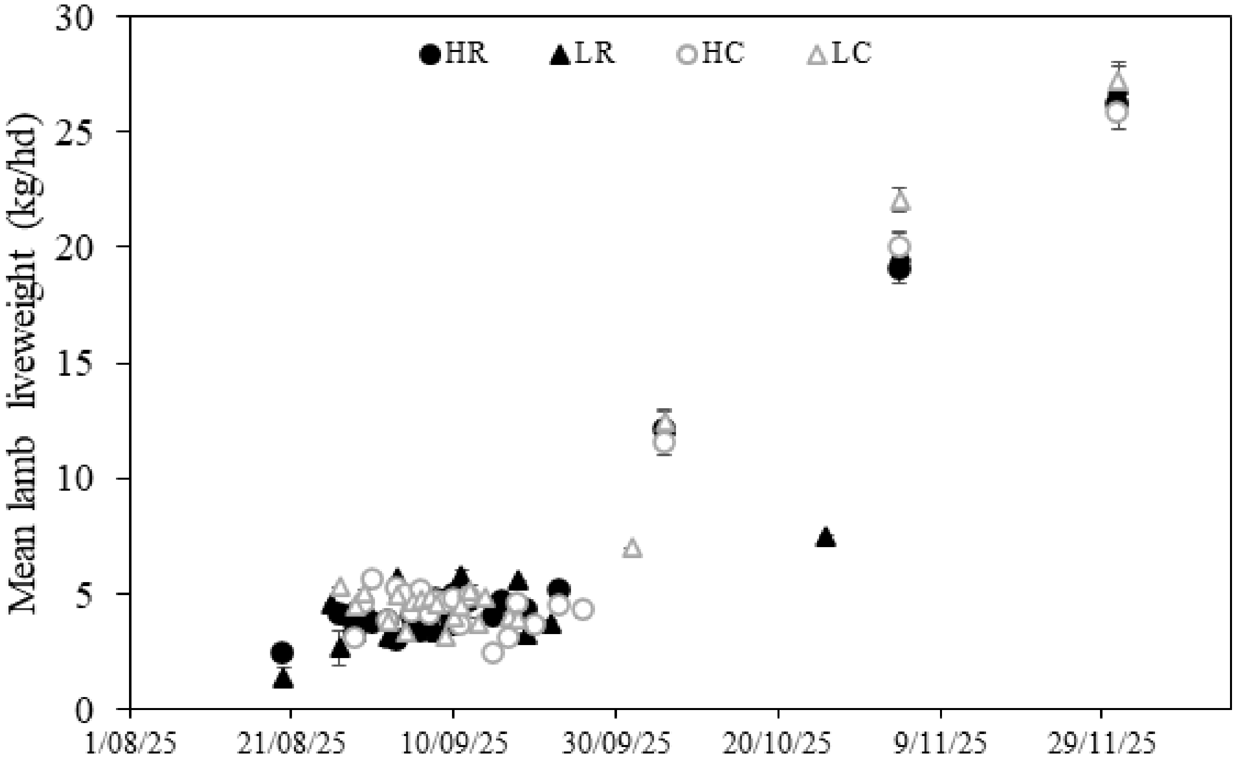


Figure 17 Average lamb liveweight from birth to December 2025.

Photo: Bob Stawasz. DPR Group, Lincoln University

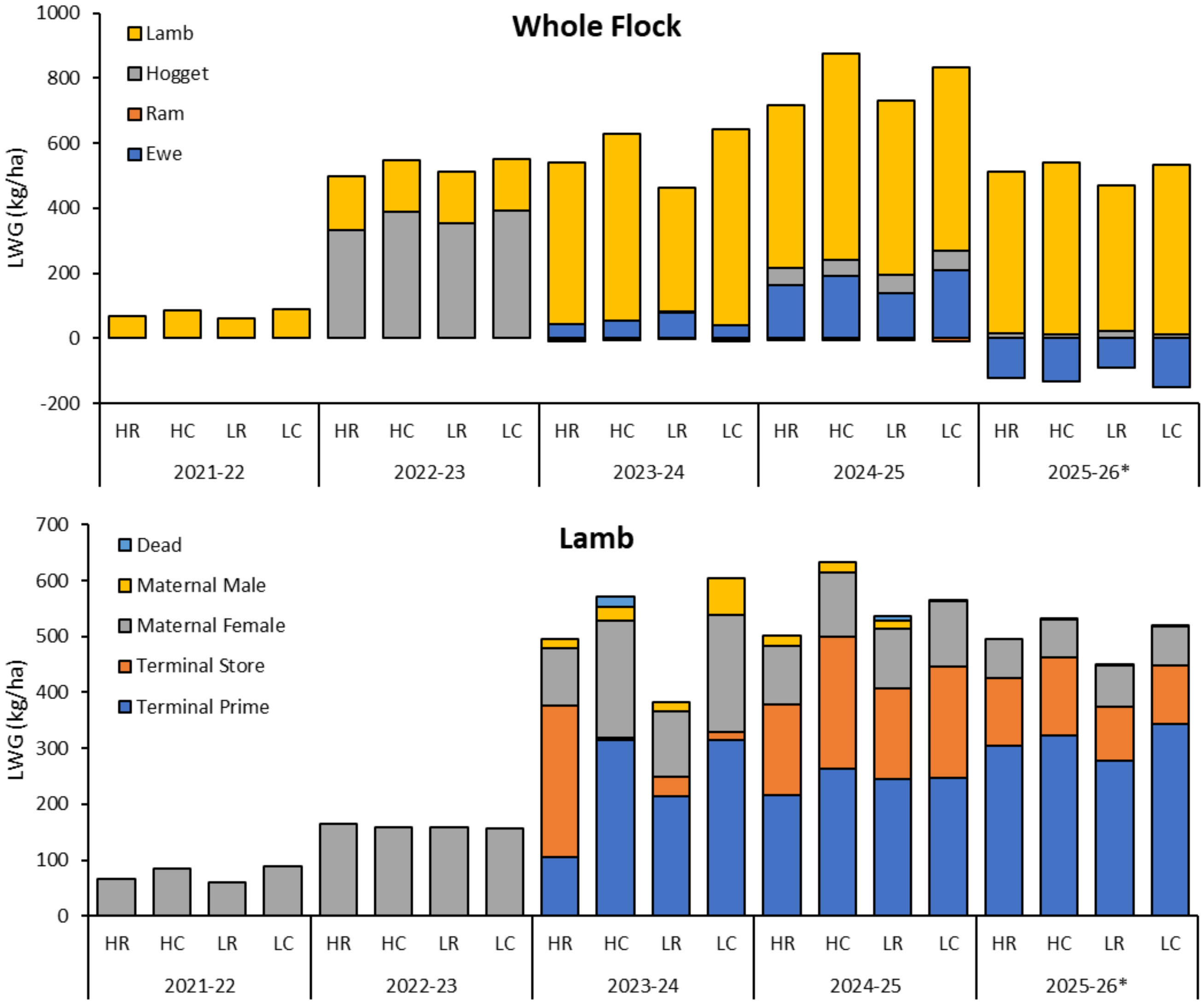


Figure 18 Annual sheep liveweight gain per hectare for the regenerative (R) and conventional (C) x high (H) and low (L) soil fertility farms. 2025-26* = 1 July to 1 December 2025.

drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

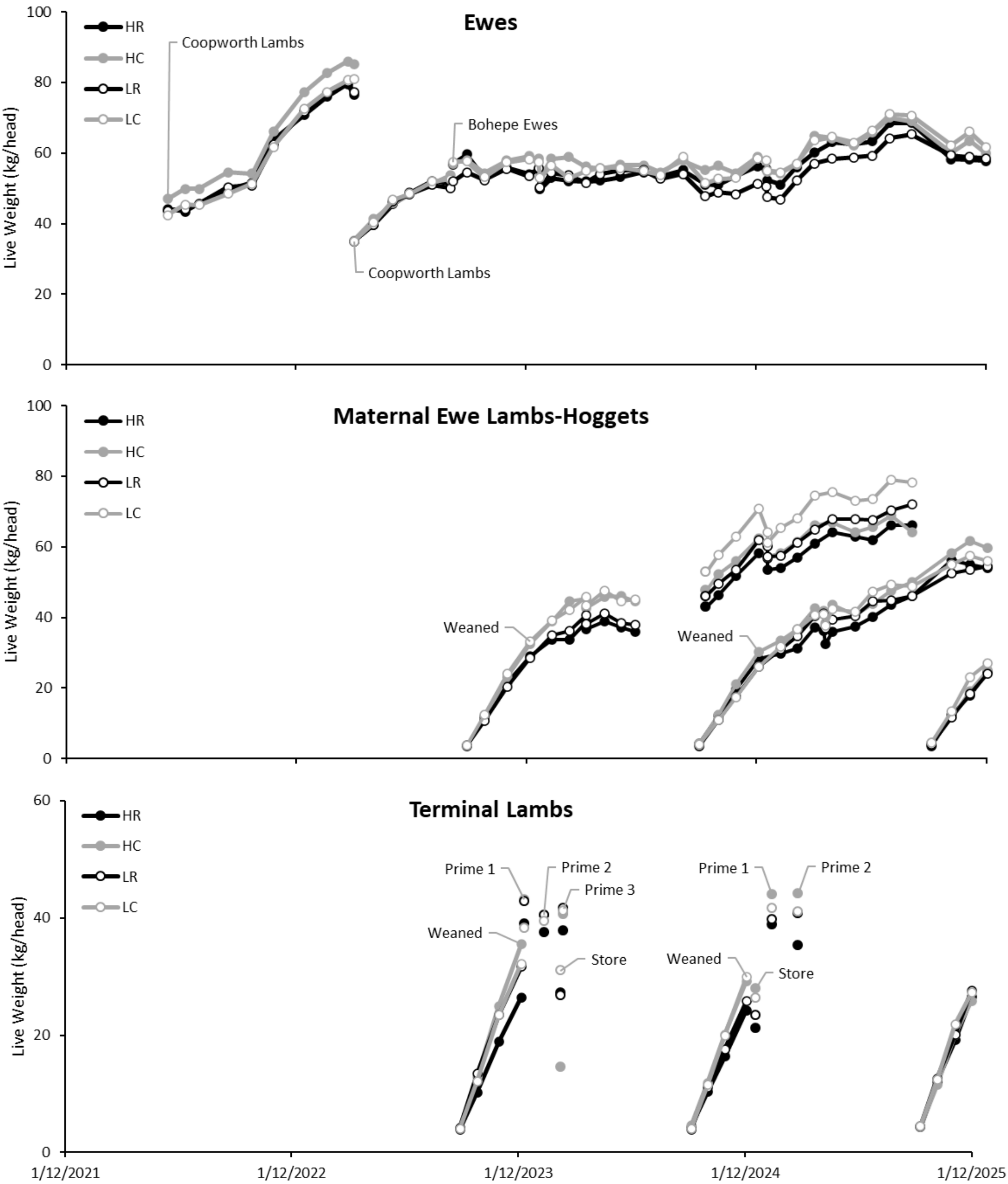


Figure 19 Average sheep live weight for the regenerative (R) and conventional (C) x high (H) and low (L) soil fertility farms.

Feed quality

Obaka Ikani – PhD student (Plants/Animals)

- An *in sacco* energy and protein supply comparison of conventional lucerne and regenerative (diverse) pasture samples was conducted at Lincoln University.
- The conventional pasture (a lucerne monoculture) had more dry matter (Figure 20) and neutral detergent fibre (Figure 21) degradation at early (3, 6, 9 h) and complete (48 h) rumen residence times.
- The increased dry matter (DM) and neutral detergent fibre (NDF) degradation during the spring suggests that lucerne intake would be greater than regenerative (diverse) pasture intakes, and higher liveweight gains would be therefore expected from conventional pasture treatments.
- The greater NDF degradation did not appear to be associated with greater NDF concentration in the treatments, which suggests that the NDF structure is more amenable to rumen degradation.
- This is a significant advance in our understanding of the limitations of regenerative systems for sheep production.

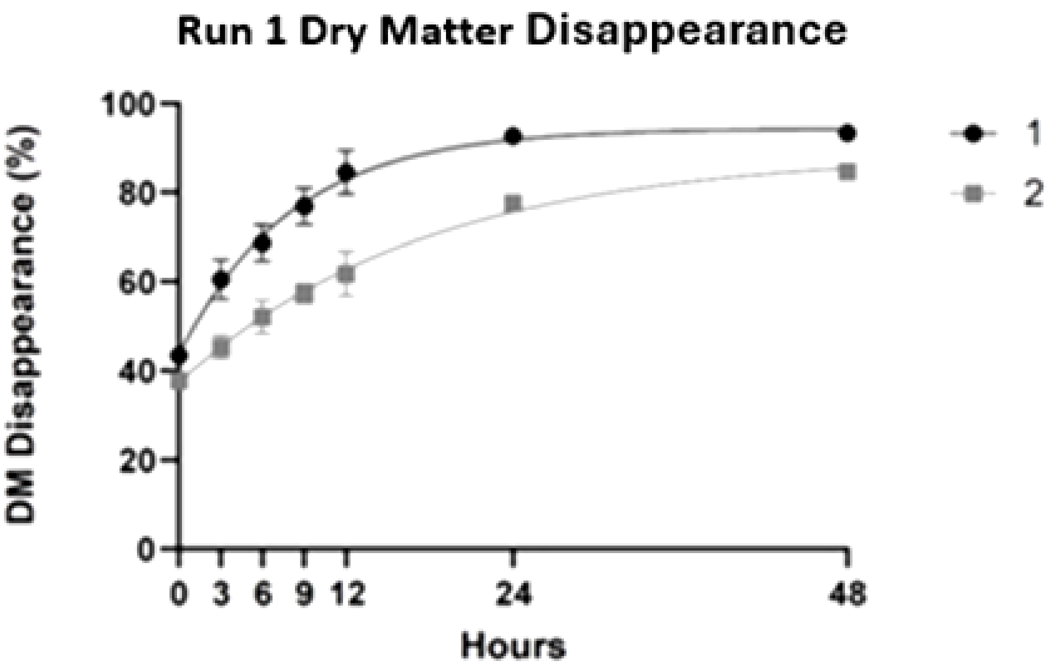


Figure 20 Dry matter disappearance (%) of Conventional (●) and Regenerative (■) pasture samples from 0 to 48 hrs.

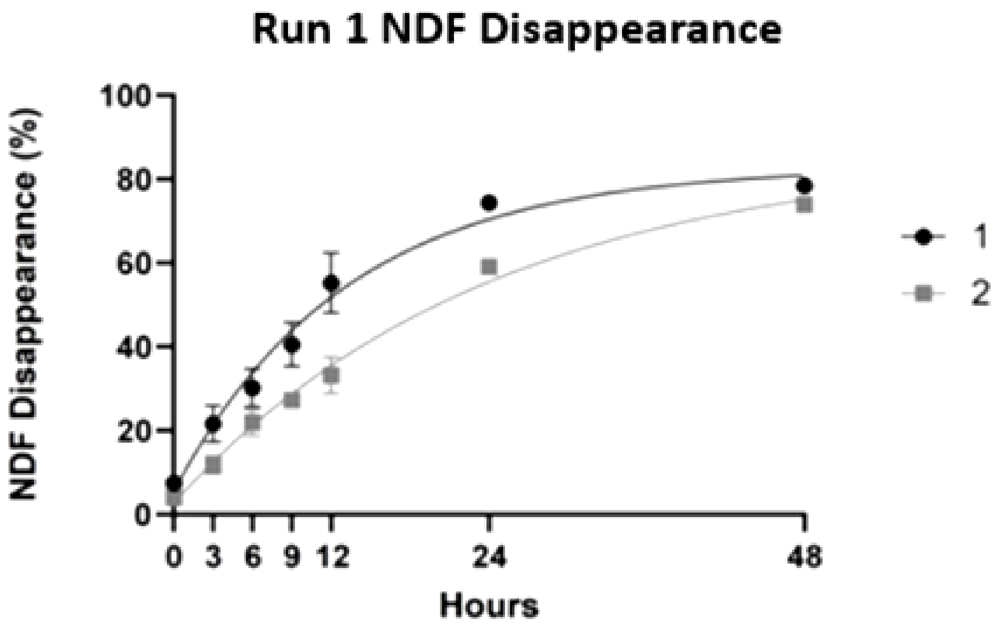


Figure 21 NDF disappearance (%) of Conventional (●) and Regenerative (■) pasture samples from 0 to 48 hrs.

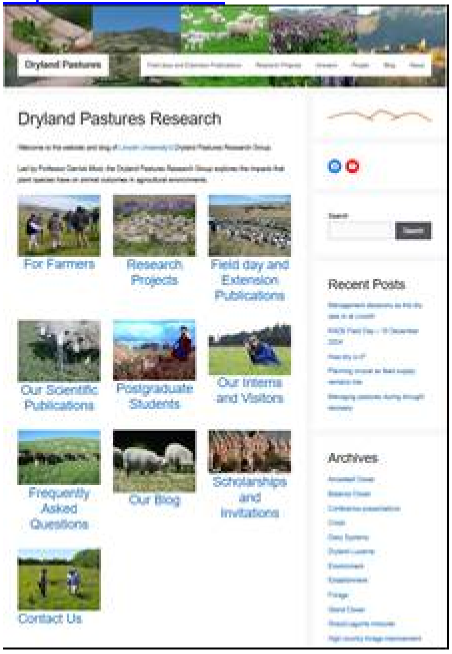
drylandpastures.com

Whenua Haumanu
Nurturing the land through exploring pastoral farming

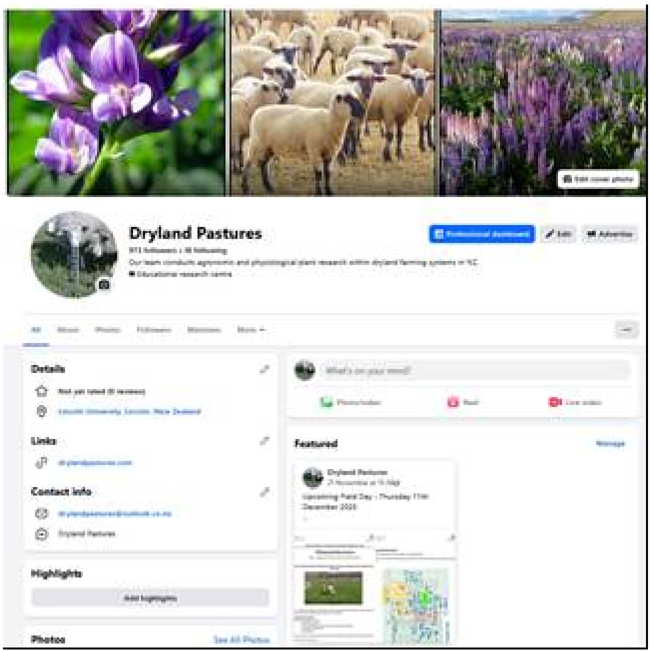
Where to find us

Website & Blog:
https://drylandpastures.com/

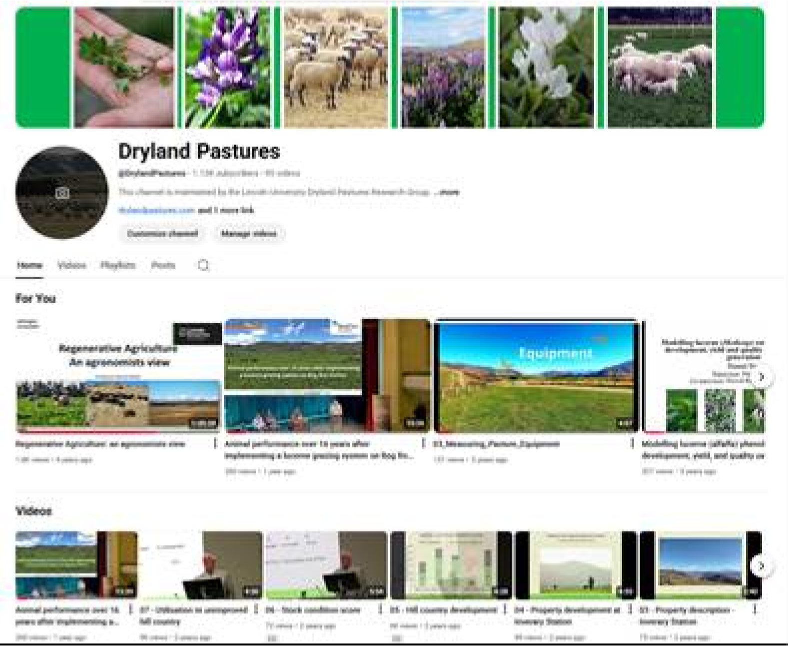
RADE project page:
https://drylandpastures.com/research-projects/regenerative-agriculture-dryland-experiment-rade/



Facebook:
https://www.facebook.com/DrylandPasturesResearch
(@DrylandPasturesResearch)



YouTube:
https://www.youtube.com/drylandpastures



drylandpastures.com

Whenua Haumanu

Nurturing the land through exploring pastoral farming

NOTES