beef+lamb new zealand GENETICS

Low Input Sheep Progeny Test

PROJECT: Ethically and sustainably produced, high-value lamb

Public Report

January 2023

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BACKGROUND

Beef + Lamb New Zealand's Taste Pure Nature origin brand is a targeted campaign for the "Conscious Foodies" who are leading the charge to understand more about how their food is produced. There is increasing consumer demand to feel confident that they are purchasing a safe, trusted product which is sustainable and responsible in terms of animal welfare and environmental health.

In alignment with this consumer demand, the ethically and sustainably produced, high-value lamb project (referred to as the Low Input Progeny Test) was established.

The general aim of "low input" farming is to reduce, as much as possible, the use of external inputs such as drenches, treatments, and labour.

The B+LNZ Genetics Low Input Progeny Test seeks to identify animals which require minimal intervention, are robustly able to combat specific diseases, and are environmentally efficient – all whilst maintaining a place in a profitable, high-quality lamb production system in extensive hill and high-country farms throughout New Zealand.

This programme aligns with New Zealand's red-meat story and positions New Zealand strongly in the global market. It is a three-year programme jointly funded by Beef + Lamb New Zealand (B+LNZ) and the Ministry for Primary Industries (MPI) with significant in-kind contributions from farmers.

Unlike other more production-based trials, where the fastest growing or most productive animals are deemed superior, the aim of this programme is to illustrate the variation and genetic potential of typical New Zealand maternal breeds who perform and thrive under a "low-input" system.

The B+LNZ Low Input Sheep Progeny Test's interpretation of a "low-input" system focuses on three main areas;

- animal welfare traits (e.g., tail length, dagginess, bareness of wool)
    - meaning lambs will ultimately not need to be docked and require less, or no treatment, for dag control and flystrike.
- breeding sheep that are disease resistant (parasites, pneumonia)
    - requiring minimal or no drench.
- breeding sheep that are environmentally efficient (methane and feed efficient)
    - produce quality lamb that is fit for purpose and underpins environmentally sustainable principles.

In partnership with breeders and MPI, the B+LNZ Genetics Low Input Progeny Test carried out at Orari Gorge Station in South Canterbury is being supported to evaluate rams for the above traits, in addition to New Zealand Maternal Worth (NZMW) traits.

Importantly, this programme will harness fundamental genomic tools developed in previous research by the Pastoral Greenhouse gas Research consortium (PGgRc) to assess sires from the breeder group to produce low methane-emitting and feed efficient lambs.

The programme has produced and measured three cohorts of lambs (born in 2019, 2020, 2021) and has generated its fourth and final cohort (2022-cohort). A full list of each cohort's sire flocks and breed compositions is listed in Appendix.

Comprehensive measurements of traits from these animals will be taken across the programme; DNA samples for parentage and genomic calibration of novel traits, weights, wool weight, wool micron, wool colour, breech & belly bareness, tail length, tail skin length, leg length, dag score, faecal egg counts, eye muscle width, depth and fat, resilience to worm burden (female lambs only), expression of oestrus (female lambs only), carcass traits (male lambs only), residual feed intake (RFI) and methane emissions.

These measurements will aid the development of breeding values for methane emission and feed efficiency as well as enhance breeding values for parasite resistance, short tail length and low propensity to produce dags and subsequent flystrike.

Figure 1. 2019-cohort two-tooth ewes on display during the Progeny Test Field Day.

ACKNOWLEDGEMENTS

Special acknowledgements: Robert & Alex Peacock and the staff at Orari Gorge Station for hosting this progeny test and dedicating their time to managing the trial animals.

The Low Input Steering Group – Robert Peacock, Alan Richardson, Kate Broadbent and Daniel Wheeler.

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Industry partners: AgResearch, PGgRc, Alliance Group Ltd, Genetics Gains Ltd - Julia Aspinall.

Participating breeders: Thank you to all the breeders who have contributed rams to the three Low Input Progeny Test cohort matings.

For a list of rams in the latest cohort, please visit our website: www.blnzgenetics.com/progeny-tests/sheep-progeny-tests

CONTACT

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REPORT SPECIFICATIONS

Within-flock SIL evaluation

This report summarises the data recorded to date as within-flock indexes and breeding values.

A within-flock evaluation uses information recorded in one flock, therefore the data presented in this report relates to the traits recorded to date in the Low Input Progeny Test Flock (5010) only.

Within-flock reporting was used because some sires come from flocks that have a long history of recording and selection for particular traits (e.g. WormFEC), and others haven't recorded or selected for some of these traits.

It is important to note these animals represent only one or two sires per birth flock – so should not be considered representative of the whole flock. Within a flock, animals can vary considerably for merit across recorded traits. Few, (if any) males are good at all traits.

Cautions

1. Within-flock reporting of indexes and breeding values restricts the data to the progeny of the sire's data in the progeny test flock (5010) only.

   It is scaled to the corrected progeny mean within flock and should not be compared with any other evaluation.
   The advantage of a within flock comparison is there is influence on the depth of data, number of relatives etc. outside the progeny test flock on the values – an "even playing field". But it does mean merit is based only on the limited data set and only for traits recorded to date.

2. The scale and spread of indexes and breeding values does not relate in any way to other evaluations (e.g., NZGE) and should not be used for any other purpose than a relative comparison within the 5010 flock.

3. Data is corrected for known environmental effects, e.g., birth date, age of dam, sex, birth rank, rearing rank and management mob, so it is a better basis for comparison than raw data.

4. Raw data is not corrected for the above listed important environmental factors. These are not necessarily equal across all sires and should not be used for direct comparisons – rather an indication of the range of values achieved under the season and management. Breeding values do correct for these known effects.

As the evaluation covers three years of data in the progeny test flock, the corrected flock mean for each trait becomes the zero value and indexes and breeding values (BVs) are scaled relative to flock average - so half the breeding values will be positive (above the flock average for the trait) and half the breeding values negative.

For sire selection decisions, B+LNZ Genetics recommends using all available information (NZGE) to get the most updated and complete estimates of genetic merit.

DATA SUMMARY – 2021 COHORT

Within Flock Index Merit 2021-Cohort

Flocks should not be judged on the basis of one sire, as there is a large amount of variation in merit within all flocks. There was also a lot of variation amongst progeny of the sires used in 2021 (some of this would have come from the dam).

Even when a sire may appear average, within his progeny there are individuals with superior performance that can be selected to enhance genetic gain.

Table1. Index merit of 2021-cohort sires within-flock **(derived from run 39710 28 Sep 2022).**

***Methane merit is across-flock, generated by NZGE analysis 39694, 23 September 2022**, demonstrates the following:

- Relative merit across sires within flock. *Index units - cents per ewe lambing.*
    - **SGMFD** – includes Survival, Growth, Meat, FEC and Dag sub-indexes.
    - **SGMFD** – includes Growth, Meat, FEC and Dag sub-indexes (does not include Survival).
- Within Flock Traits (Better than average for trait, lower than average for trait).
    - **DPS** – Dual Purpose Survival Index, in cents per ewe lambing. Within flock survival accuracy is <u>very low</u> due to the small amount of information available, therefore little emphasis should be placed on this index.
    - **DPG** – Dual Purpose Growth Index, in cents per ewe lambing, includes weaning weight, liveweight 8 and carcass weight.
    - **DPM** – Dual Purpose Meat Index, in cents per ewe lambing, includes both ultra-sound eye muscle scanning and VIAscan data.
    - **DPD** – Dual Purpose Dag Index, in cents per ewe lambing, is based on dag scores at weaning (DAG3) and liveweight 6 or 8 (DAG8) and adult dag on ewes.
    - **DPF** – Dual Purpose Internal Parasite Resistance Index, in cents per ewe lambing, includes FEC1 taken in March on both sexes and FEC2 taken in May on females only.
    - **TLENSCrBV –** tail length score research breeding value is converted from the raw measurement in centimetres to a 3-point tail length score (1-short<15cm, 2-medium 15-25cm, 3-long >25cm). A more positive value indicates longer tail length, a more negative value is desirable. Shorter than average tail length, longer than average tail length.
    - **TSKINrBV –** tail bare skin length research breeding value estimates length of bare skin area on the underside of the tail. A more positive value indicates longer tail bare skin length. Longer than average bare skin length under tail, shorter than average bare skin length under tail.
- NZGE derived merit - information generated by NZGE, **not within flock analysis**. Methane merit is across-flock, generated by **NZGE analysis 39694, 23 Sep 2022.**
    - **PACCH4 gBV** – PAC methane emissions genomic breeding value estimates methane emitted (through the Portable Accumulation Chamber – PAC) in grams of methane (CH_4) per day per kg of feed eaten. A more positive value indicates higher emissions, a more negative value is desirable.
      Table1 shows less methane emitted than zero gCH4/day/kg feed eaten, compared to more methane emitted than zero gCH4/day/kg feed eaten. *Note the average for these sires is 0.270gCH4/day/kg feed eaten, so even if the bar is red (more than zero), it may still be less than the average for the cohort, the dots indicate above-average and below-average for this cohort.*

*Table1. Index merit of 2021-cohort sires **within-flock** (derived from run 39710 28 Sep 2022).*
Methane merit is across-flock, generated by NZGE analysis 39694, 23 September 2022.
Note – DPS accuracy is low, only based on lamb direct survival, and variable numbers of progeny per sire - little emphasis should be placed on this index.

Sire Birth ID	Overall (SGMFD) (cents)	Overall (GMFD) (cents)	DPS (cents)	DPG (cents)	DPM (cents)	DPF (cents)	DPD (cents)	TLENSC rBV (score)	TSKIN rBV (cm)	*PACCH4 gBV (g CH4/day)
228.136/18										
630.223/16										
712.5203/04										
845.200/19										
1425.620/16										
1811.1146/19										
1973.56/19										
2191.200/10										
2629.1173/19										
2744.51470/19										
2749.2309/19										
2759.7569/16										
3579.191661/19										
3855.FR1999/19										
4851.623/19										
4949.2128/18										
4989.563/19										

Mating & Pregnancy Scanning

In November 2020, expressions of interest were opened to the industry to nominate flocks for consideration in the 2021-cohort mating of the Low Input Progeny Test.

Twenty-seven respondents expressed interest in submitting a sire to the trial, reiterating the growing public interest in the project felt from this year's field day and previous events. The Low Input Steering Group along with B+LNZ Genetics, met in mid-December 2020 to discuss the merit of each nomination and ultimately decide on which to include.

When nominations opened, a forward to the application detailed that as a driver for industry change, preference would be given to flocks currently recording, or who show intent to record, "Low-input traits" in their own flocks. "Low-input traits" may include, but are not limited to, dag score, parasite resistance, tail traits, and methane. This formed a major part of the criteria for selection alongside genetic connectedness in SIL.

As a result of these expressions of interest, 14 industry flocks were selected, including three flocks which have not entered rams into this trial previously.

A further three rams were allocated as link sires[1], totalling 17 sires (all HD genotyped by GenomNZ) to produce the 2021-cohort (see "Deliverables/Evidence of completion" section for a list of the 2021-cohort sires).

As mentioned in a previous report, one of the link sires is an animal used in the larger B+LNZ Genetics RFI study as well as in the Low Input 2021-cohort mating to allow for genetic linkages between the two studies.

1268 mixed age ewes, including 413 2019-cohort two-tooth ewes, were weighed and body condition scored (BCS) in March 2021. An average liveweight across these ewes of 60.7kg was recorded alongside a 3.3 average BCS which is both heavier and better conditioned than the 2020-cohort.

Anything under a BCS of 2 was removed from the trial and was not programmed to undergo artificial insemination (AI).

A total of 1153 of the ewes were programmed for AI including 413 of the 2019-cohort two-tooth ewes.

Over a period of 5 days in April 2021 a team of staff (Figure 2), completed the AI of 1029 ewes.

AI ewes were followed up naturally with 18 commercial sires across the mixed age and 2019-cohort two-tooth ewe mobs for 32 days from 30th April to 1st June.

Pregnancy scanning of the 2021-cohort mated trial ewes was carried out by Daniel Wheeler, one of our steering group breeders on 17th June 2021.

The 1029 AI ewes scanned an 80% conception rate which is an excellent result for such a large programme.

AI conception rate for the 2020-cohort was roughly 84% though this was for only 300 ewes.

The overall number of foetuses to ewes mated for the 2020-cohort was approximately 131% and for the 2021-cohort approximately 141%, a good jump on last year aided by the great conception rate of the AI programme.

A follow up scan for naturally mated ewes was undertaken on 9th July 2021.

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[1] Link sires provide genetic connections across flocks and/or years which benefit the accuracy of genetic information.

Figure 2 Staff involved in the 2021- cohort AI programme.

Lambing

Ewes were pregnancy scanned and split into six mobs and set stocked for lambing:

- one mob of singles
- four mobs of twins
- one mob of triplets.

The weather was very kind over lambing which contributed to a high percentage of lambs docked to lambs scanned.

Docking/Tailing

On the 29th September 2021, a large team of Orari Gorge farm staff, B+LNZ Genetics, contract and casual staff set out to dock/tail 1143 progeny test 2021-cohort lambs (586 females and 557 males).

Figure 3. Early morning muster of 2021-cohort ewes and lambs coming in for docking.

Due to Covid-19 restrictions, the docking crew wore masks to ensure social distancing around the docking chute.

Once drafted from the ewes, lambs were tagged with an Electronic ID (EID) tag and a tissue sample for DNA parentage was taken using a tissue sampling unit (TSU). The EID, TSU, sex and tail traits were recorded including length of tail, length of skin under tail, length of leg (hock to anus), caudal fold length and length of tail required to cover the vulva.

Averages, maximums and minimums for each trait are shown in Table 2. Tail traits can vary between breeds and are recorded to establish the relationship between the bareness, length of tail and an animal's propensity to form dags.

Table 2. 2021-cohort lamb tail measurements.

Measure	Average (mm)	Min (mm)	Max (mm)
Tail Skin	75.5	9.0	190.0
Tail Length	209.7	80.0	300.0
Leg Length	165.3	75.0	200.0
Caudal fold	49.2	25.0	456.0
Vulva Length	56.3	15.0	85.0

Table 2 demonstrates the variation across the 2021-cohort lambs for tail length traits. It is important to note here the ability of the sire to impact their progeny.

Figure 4. Showing the measurement of tail traits, and the docking team hard at work on a beautiful South Canterbury day.

Animal welfare regulations for tail docking

2021 was the first year under the newly enforced Animal Welfare regulations around tail length.

Feedback we heard from farmers suggested there was confusion around what the regulation was aiming to achieve. As a result, several additional measures were recorded on these lambs, including:

- length from the anus to the distal end of the caudal fold on all lambs
- for ~10% of lambs (females only) the length of tail required to cover the vulva.

These additional measures found that docking tails at the distal end of the caudal fold only covered the vulva in 30% of animals in this study. It was recommended to MPI that further clarity is provided to farmers regarding the intent of the tail length regulation i.e. if the purpose is to cover the vulva or not.

Ewe lambs in this trial had their tails docked with a rubber ring at a length to cover the vulva, not at the distal end of the caudal fold.

Male lambs did not get tail docked but did get turned into cryptorchids[2].

- **TLENSCrBV –** tail length score research breeding value is converted from the raw measurement in centimetres to a 3-point tail length score (1-short<15cm, 2-medium 15-25cm, 3-long >25cm). A more positive value indicates longer tail length, a more negative value is desirable. Shorter than average tail length, longer than average tail length.
- **TSKINrBV –** tail bare skin length research breeding value estimates length of bare skin area on the underside of the tail. A more positive value indicates longer tail bare skin length. Longer than average bare skin length under tail, shorter than average bare skin length under tail.

Table 3. Within flock genetic merit for tail traits for 2021-cohort sires, scaled to the corrected progeny mean.

Sire Birth ID	TLENSC rBV (score)	TSKIN rBV (cm)
228.136/18		
630.223/16		
712.5203/04		
845.200/19		
1425.620/16		
1811.1146/19		
1973.56/19		
2191.200/10		
2629.1173/19		
2744.51470/19		
2749.2309/19		
2759.7569/16		
3579.191661/19		
3855.FR1999/19		
4851.623/19		
4949.2128/18		
4989.563/19		

Weaning

1103 lambs were weaned on the 8/12/21: 563 ewe lambs averaging 22.7 kg and 530 male lambs averaging 24.9 kg. Both sexes were on average around 3kg back on last year despite weaning at roughly the same age.

DNA parentage was returned prior to weaning to determine their sire match. Those not returning a full DNA match were marked as control animals and run within the same

[2] Cryptorchids = male lambs have a rubber ring applied to their scrotum, below the testicles, which eventually causes the scrotum to atrophy and holds the testes against the abdomen where the increase in testicular temperature makes most animals infertile.

contemporary groups (though not genetically comparable). There were also an additional 34 animals bred by the host farm commercially which have also joined the group as control animals.

At weaning all lambs were drenched and run as separate mobs (male and ewe lambs) after weaning.

Lambs were scored on their propensity to form dags at weaning, the average score was 0.33 across both sexes, which is slightly more than last year's average at weaning[3].

Ewes were weighed and body condition scored (BCS) at mating and again at weaning. At mating, 1268 ewes weighed an average of 60.7 kg with a BCS of 3.3. At weaning, those ewes which produced a lamb on average weighed 58.8 kg with a BCS of 2.8 and a dag score of 1.8.

Growth

Liveweights were recorded monthly on both sexes of the 2021-cohort lambs post-weaning, alongside other measurements.

Figure 5 demonstrates the growth rate pattern for both the 2020 and 2021-cohort males and females across their respective seasons.

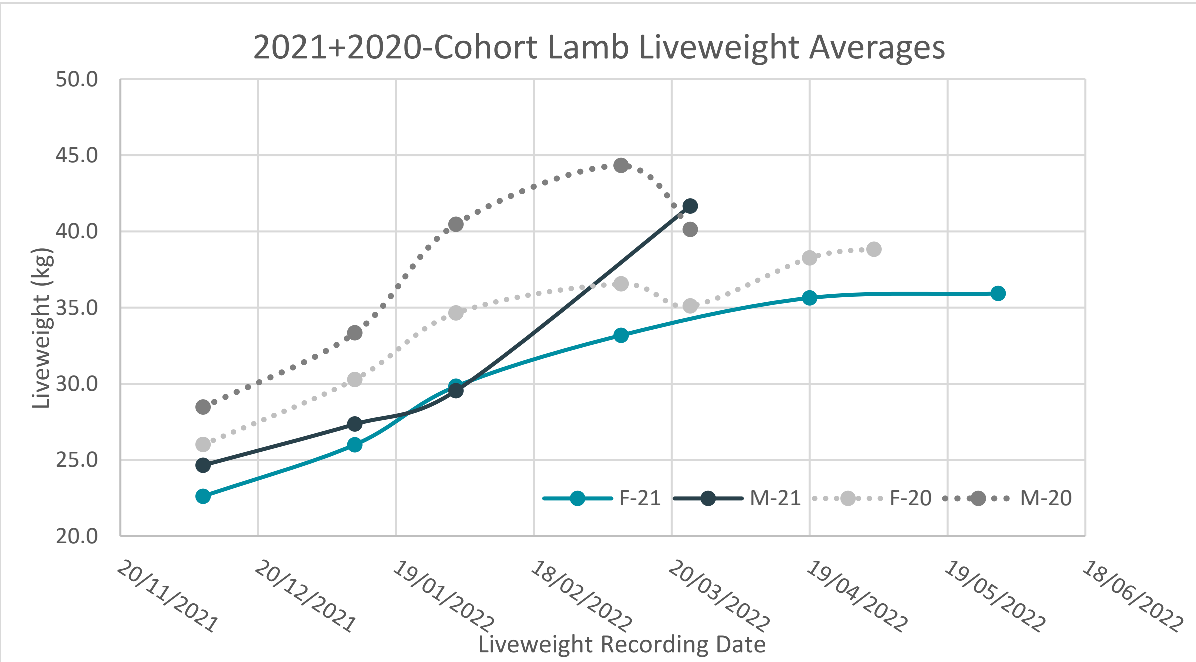


Figure 5. Liveweights of 2021-cohort lambs from weaning (Dec 2021) to June 2022, alongside the 2020-cohort liveweights over the same season the year previous.
F-21= 21-cohort females, M-21= 21-cohort males, F-20= 20-cohort females, M-20= 20-cohort males.

Both the males and females of the 2021-cohort grew steadily from weaning in December 2021. In January 2022, due to a particularly wet and humid season, growth rates were affected by the seasonal parasite challenge.

This is further described in the following section, **Error! Reference source not found.**.

There were significant differences in birth and rearing rank between sires, so raw data is not the best indication of sire performance.

[3] Dag score is measured on a scale of 0 to 5, where 0 is no dag and 5 is very daggy.

- **DPG** – Dual Purpose Growth Index, in cents per ewe lambing, describes the relative merit for growth across sires within flock.
- **WWTeBV** – weaning weight eBV, in kilograms of liveweight, is an estimate of pre-weaning growth rate. A more positive value indicates higher liveweight (Better than average for trait, lower than average for trait).
- **LW8eBV** – liveweight at 8-month eBV, in kilograms of liveweight, is an estimate of autumn liveweight – post weaning growth (Better than average for trait, lower than average for trait).

Table 4. Within flock genetic merit for growth traits for 2021-cohort sires.

Sire Birth ID	DPG (cents)	WWT eBV (kg)	LW8 eBV (kg)
228.136/18			
630.223/16			
712.5203/04			
845.200/19			
1425.620/16			
1811.1146/19			
1973.56/19			
2191.200/10			
2629.1173/19			
2744.51470/19			
2749.2309/19			
2759.7569/16			
3579.191661/19			
3855.FR1999/19			
4851.623/19			
4949.2128/18			
4989.563/19			

It is important to note that while some animals appear to rank poorly for growth in this data set, they may rank differently under different animal health management programmes. Also as explained in the report specifications, this data is only relevant to this flock, so generally, half the population will be deemed above and half below average, but could still be above industry average.

This progeny test is unlike other more production-based trials, where the fastest growing or most productive animals are deemed superior. The aim of the Low Input Progeny Test programme is to illustrate the variation and genetic potential of typical New Zealand maternal breeds who perform and thrive under a "low-input" system.

Faecal egg counts (FEC)

Worm FEC levels were measured on all lambs (both sexes) in February 2022 and on all remaining lambs (females only) in March.

Table 5. Average eggs per gram (epg) from female and male 21-cohort lambs in February and March 2022 recording events.

Sex	FEC Measure	Date	Number of animals	Mean
Females	FEC1	2/02/2022	537	732
	FEC2	18/03/2022	502	4450
Males	FEC1	2/02/2022	475	3120

All 2021-cohort lambs received an oral drench at weaning. Table 5 demonstrates the average FEC values for the female progeny at the two measures and males at the first. Sires which have low FEC averages at both measures are superior as their progeny have shed fewer eggs in total.

Animals are regularly monitored by farm staff, with individuals displaying clinical symptoms of a high parasite burden treated with drench immediately and removed from the trial. Clinical signs of excess worm burden include rapid weight loss, excessive scouring, hollow stomach, droopy ears, and listlessness.

Notes

Orari Gorge has worked to improve the parasite resistance of the Orari Gorge Romney ewe flock so there may be some merit being contributed from ewes as well as sires.

Long stretches of wet weather combined with warm, humid temperatures over the summer of 2022 saw a perfect environment for gastrointestinal worm reproduction in the pasture. This caused an early and significant worm challenge for the trial animals.

This contributed to the Animal Ethics adverse event 296 – describing unexpected injury or death during application approval period. The resulting outcome to mitigate this adverse event included increased monitoring for worm burden to allow early detection and management.

This challenge has caused a decrease in growth rate for some lambs and in some severe cases, death. Though there was no veterinary post-mortem on the dead lambs to identify the excessive worm burden as the cause of death, based on farm manager experience this was the conclusion reached.

This trial seeks to minimally drench animals, however, this significant worm challenge has meant that all animals have been drenched within 8 weeks of their weaning drench to combat this challenge.

All animals have responded differently to the parasite challenge partly due to genetics which is what this trial seeks to identify. The majority of animals have seen at least a reduction in potential liveweight gain. A portion have seen minimal or negative liveweight gains, several animals were treated (drenched) and removed from the trial (n=38) and a smaller portion (n=14) died due to the challenge.

- **DPF** – Dual Purpose Internal Parasite Resistance Index, in cents per ewe lambing, includes FEC1 taken in March on both sexes and FEC2 taken in May on females only.
- **FEC1eBV** – faecal egg count prior to March eBV estimates Faecal egg count in lambs, late summer. A more positive value indicates higher egg counts, a more negative value is desirable.
- **FEC2eBV** – faecal egg count from March eBV estimates Faecal egg count in lambs, autumn. A more positive value indicates higher egg counts, a more negative value is desirable.

Table 6. Within flock genetic merit for worm resistance for 2021-cohort sires.

Sire Birth ID	DPF (cents)	FEC1 eBV (epg)	FEC2 eBV (epg)
228.136/18			
630.223/16			
712.5203/04			
845.200/19			
1425.620/16			
1811.1146/19			
1973.56/19			
2191.200/10			
2629.1173/19			
2744.51470/19			
2749.2309/19			
2759.7569/16			
3579.191661/19			
3855.FR1999/19			
4851.623/19			
4949.2128/18			
4989.563/19			

Dag Scoring

All lambs were scored (DAG3) at weaning in December 2021 and in March 2022 (DAG8). Male lambs were left untailed, while female lambs were tailed. The average dag scores can be seen in Table 7.

Table 7. 21-cohort lambs, average dag scores by sex.

Sex	# animals	DAG3	DAG8
Male (long tail)	547	0.37	(24-Mar) 1.73
Female (docked tail)	580	0.29	(9-Mar) 2.55

Dag scoring is a visual score based on the scale illustrated in Figure 6.

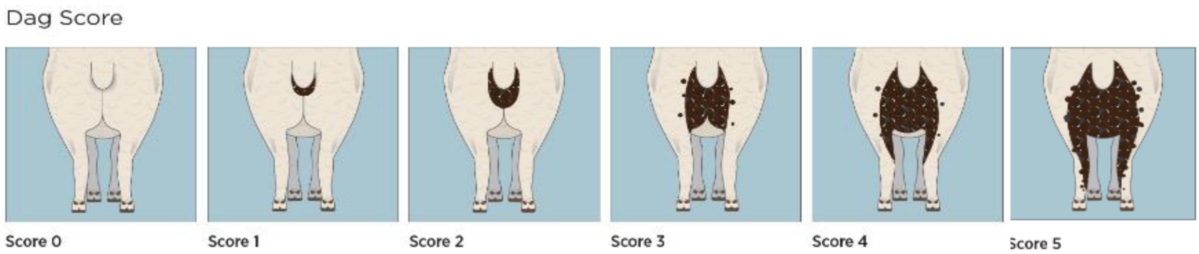


Figure 6. B+LNZ Genetics Visual Dag Score scale.

Lambs were dipped for flystrike at weaning in December 2021 and then in late January 2022. Despite a major presence of dags in the male lambs, there were very minimal issues with flystrike.

Table 8. Incidence of progeny dag scores for males (long tails) in three increments, by 2021-cohort sires and control group.

Sire Birth ID	Dag Score 0-1	Dag Score 2-3	Dag Score 4-5
228.136/18	24%	46%	30%
630.223/16	24%	49%	27%
712.5203/04	24%	50%	26%
845.200/19	43%	48%	9%
1425.620/16	44%	39%	17%
1811.1146/19	44%	50%	6%
1973.56/19	36%	51%	13%
2191.200/10	29%	54%	17%
2629.1173/19	40%	55%	6%
2744.51470/19	41%	44%	15%
2749.2309/19	43%	48%	10%
2759.7569/16	18%	49%	34%
3579.191661/19	56%	36%	9%
3855.FR1999/19	31%	49%	20%
4851.623/19	30%	46%	24%
4949.2128/18	29%	58%	14%
4989.563/19	66%	34%	0%
Control	51%	38%	11%

As shown in Figure 6Table 8, the higher the score, the higher the level of dagginess.
Table 8 demonstrates the proportion of each sire's progeny in each score bracket. **Error! Reference source not found.**A higher incidence or proportion at a lower score is most desirable.

It is important to note that all sires had some progeny that had none or very few dags, even though they remained undrenched with tails. While some sires who had higher proportions of progeny recording high dag scores, they also still had some with low scores.

This highlights an opportunity for flocks to take advantage of the variation within sires.

Table 9 describes the indexes and breeding values explained below.

- **DPD** – Dual Purpose Dag Score Index, in cents per ewe lambing, based on dag scores at weaning (DAG3) and liveweight 6 or 8 (DAG8) and adult dag on ewes.
- **LDAGeBV** – lamb dag score (includes DAG3 and DAG8). A more positive value indicates higher predisposition to produce dags, a more negative value is desirable.
- **ADAGeBV** – adult dag score (measured on ewes annually). A more positive value indicates higher predisposition to produce dags, a more negative value is desirable.

Table 9. Within flock genetic merit for propensity to form dags for 2021-cohort sires.

Sire Birth ID	DPD (cents)	LDAG eBV	ADAG eBV
228.136/18			
630.223/16			
712.5203/04			
845.200/19			
1425.620/16			
1811.1146/19			
1973.56/19			
2191.200/10			
2629.1173/19			
2744.51470/19			
2749.2309/19			
2759.7569/16			
3579.191661/19			
3855.FR1999/19			
4851.623/19			
4949.2128/18			
4989.563/19			

For reference when comparing Table 8 and Table 9, if looking for example at the final sire 4989.563/19 in Table 8, note that he has 66% of his progeny recording low scores, and only 11% recording high scores. This can be seen in the Table 9 as he has large teal index and breeding value bars, indicating a high index value and low breeding values indicating low propensity to form dags.

Muscle scanning

500 male lambs were ultra-sound muscle scanned on 24th March 2022. Eye muscle depth (EMD), eye muscle width (EMW) and fat depth (FDM) are measured in mm (Table 10) and loaded into the New Zealand Genetic Evaluation to produce eye muscle area estimated breeding value (EMAceBV) in cm^2.

Table 10. Average eye muscle scanning measurements for 21-cohort lambs.

Group	# animals	Average Liveweight (24/3/22)	Average EMD (mm)	Average EMW (mm)	Average FDM (mm)
Control	19	38.7	23.9	62.5	3.4
Trial males	481	41.8	25.1	64.3	3.5
Total	**500**	**41.7**	**25.1**	**64.3**	**3.5**

Caution
Eye muscle area is strongly associated with liveweight/size and raw values can be very misleading – larger animals will have a larger eye muscle, but the question is: "is it above or below average for its size?"
Breeding values are a much more accurate indication of merit as they calculate merit, corrected for size.

Table 11 in the Lamb slaughter section demonstrates the meat trait merit by index and breeding values.

Lamb slaughter

Pre-slaughter live-weights of 497 male lambs of the 2021-cohort were taken on 24th March 2022. These ranged from 26 to 56kg with an average of 41.7kg including control lambs.

These lambs were trucked to Alliance Smithfield in Timaru and processed on 29th March 2022. Unfortunately due to covid-19 restrictions, only plant staff were able to be on site for this kill.

Average hot carcass weight (HCW) was 17.4kg, ranging from 11.6 to 25.9kg. VIAScan GR fat measurements ranged from 1 to 17.2mm, and yields varied from 44 to 61% (excluding cutters[4]).

- **DPM** – Dual Purpose Meat Index, in cents per ewe lambing, includes both ultra-sound eye muscle scanning and VIAscan data.
- **CWeBV –** carcass weight eBV, in kilograms, is an estimate of carcass weight, informed predominately by post-weaning liveweights. A more positive value indicates higher carcass weight, (better than average for trait, lower than average for trait).
- **LEANYeBV** – lean yield eBV, in kilograms, is an estimate of average overall meat yield merit. A more positive value indicates higher carcass lean (muscle), (better than average for trait, lower than average for trait).

Table 11. Within flock genetic merit for meat traits for 2021-cohort sires.

SIL Bth Id	DPM (cents)	CWYeBV (kg)	LEANYeBV (kg)
228.136/18			
630.223/16			
712.5203/04			
845.200/19			
1425.620/16			
1811.1146/19			
1973.56/19			
2191.200/10			
2629.1173/19			
2744.51470/19			
2749.2309/19			
2759.7569/16			
3579.191661/19			
3855.FR1999/19			
4851.623/19			
4949.2128/18			
4989.563/19			

As explained in the report specifications, this data is only relevant to this flock, therefore half will be deemed above and half below average, but could still be above industry average.

[4] Cutter = carcass with a fault that causes a section of the carcass to be cut off therefore affecting the total carcass weight and yield.

Hogget Oestrus

Vasectomised (teaser) rams fitted with harnesses and crayons were joined with the 2021-cohort ewe lambs in May 2022. Those ewes who exhibited oestrus were marked by the teaser's harness crayons.

Approximately 62% of the 515 2021-cohort ewe hoggets demonstrated oestrus (were marked by the teasers), the remaining 38% were not marked.

Marked ewes had an average liveweight of 37.3kg, unmarked ewes recorded an average liveweight of 33.6kg after their exposure to teasers.

As Figure 7 shows both 2021 and 2020-cohorts, for comparison, approximately 67% of the 2020-cohort ewe lambs demonstrated oestrus with an average liveweight of 39.9kg, while the remaining 33% were not marked with an average liveweight of 36.8kg.

Table 12. Number of marked and unmarked 2021-cohort ewe hoggets in weight brackets.

Liveweight	Marked	Unmarked	Total	Oestrus %
<35kg	85	123	208	41%
35-39kg	150	62	212	71%
40-50kg	83	12	95	87%
Total	**318**	**197**	**515**	**62%**

Based on Table 12 above, it would be fair to assume that the heavier the weight, the more likely oestrus is to be exhibited. However, Figure 7 discredits this as there are sires represented by progeny at lower weights with higher incidences of oestrus.

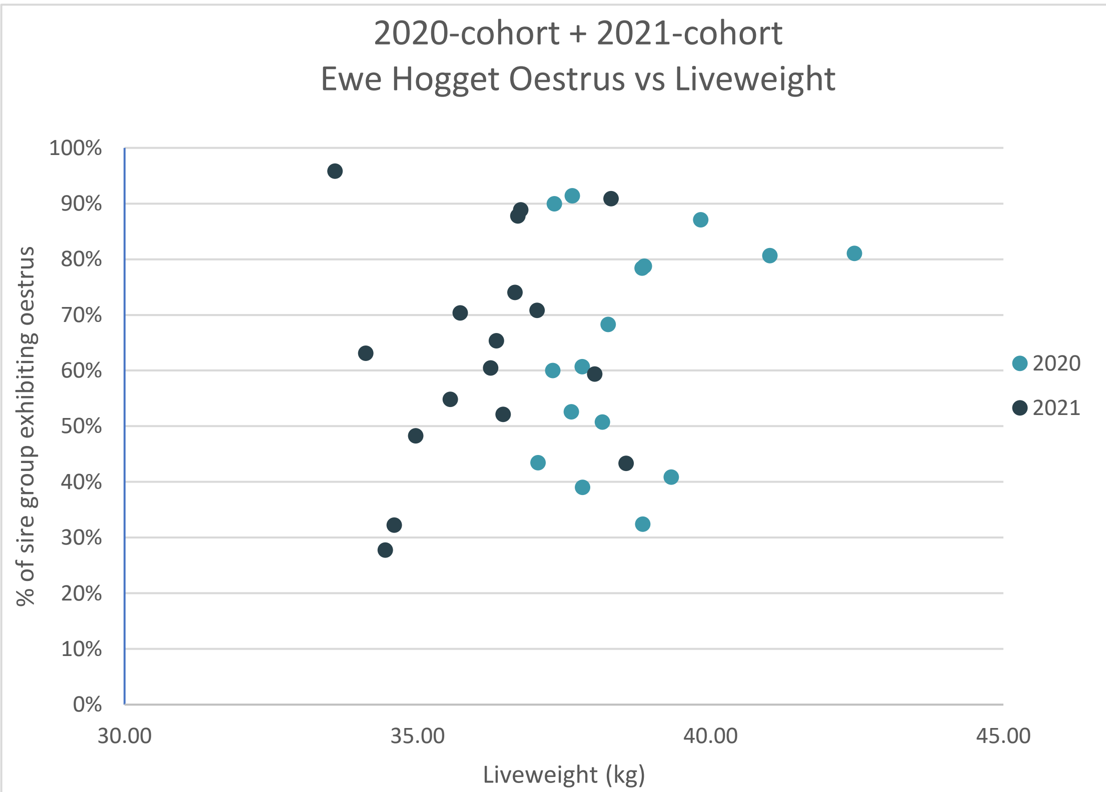


Figure 7. Liveweights of 2020 and 2021-cohort lambs and their corresponding percentage of sire group demonstrating oestrus.

This demonstrates that there is a genetic component to hogget oestrus. This means that there will be light animals which, if exposed to entire rams would conceive. Therefore, it is important to be mindful of using liveweight as a tool for mating hoggets, it is not necessarily safe to assume light ewes will not get in lamb.

<u>Methane emissions & rumen sampling</u>

In April 2022, 251 of the 2021-cohort ewe hoggets were measured through PAC, on grass at Orari Gorge Station. Approximately 15 progeny per sire were represented.

Figure 8. PAC trailer set up at Orari Gorge Station.

In July 2022, 204 of the same 2021-cohort ewe hoggets were also measured off lucerne pellets at the Invermay Feed Intake Facility. Approximately 12 progeny per sire were represented.

Methane measures have now occurred across 3 cohorts of this trial (2019, 2020 and 2021) both off grass and on pellets.

All methane measures captured during this trial from animals fed on both grass (740) and on lucerne pellets (563) were collated and are contributing to the New Zealand Genetic Evaluation (NZGE).

Recorded volumes of methane and carbon dioxide in parts per million (ppm) were converted to grams per day and can be reported within NZGE reports generated for participating breeders.

1295 of the above-mentioned animals have also contributed to another project where rumen microbial profiles were collected and used to predict methane.

Figure 9. Rumen samples from 2020-cohort ewe lambs collected during methane measurements at Orari Gorge.

Using oral stomach tubing, a sample of rumen fluid is collected (shown in Figure 9) from each animal prior to going into the PAC trailer.

These samples were stored in preservative and the microbiomes have been sequenced as part of the other project where results were recently presented at the World Congress in Genetics applied to livestock production (Bilton, et al., 2022).

Results

- There was clear genetic variation within methane breeding values, with a spread of approximately 10% above and 10% below the average for the grass-based breeding value.
- Pellet-based estimates were greater with a variation of 20% above and 20% below the average.
- The methane breeding values showed variation amongst individuals indicating sires can be selected based on their methane emissions.

- Accuracies for prediction of methane using microbiomes were low but limited by number and in line with other estimates.

The data from this project flock has been used to help with the analysis of other studies and the flock is well represented in the variation captured by these analyses. The flock has contributed significantly to the national inventory of methane emissions, to the existing knowledge base and to sample collection and method development.

Data from this work is helping identify low methane emitting animals by considering this information in association with both phenotypic and genotypic information to ultimately select for heritably lower methane emitting sheep.

Recorded volumes of methane and carbon dioxide in parts per million (ppm) were converted to grams per day and reported into the NZGE.

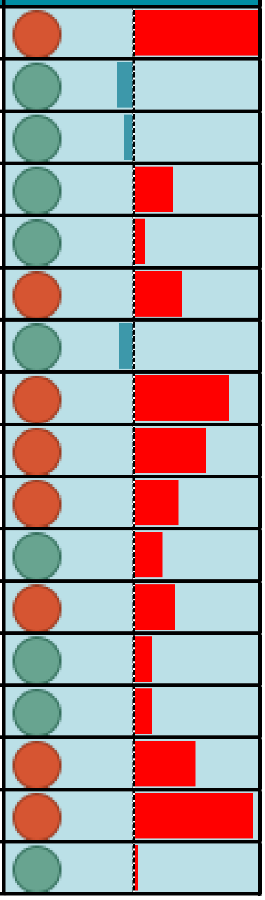
NZGE derived merit - information generated by NZGE, **not within flock analysis**.

- **PACCH4 gBV** – PAC methane emissions genomic breeding value estimates methane emitted (through the Portable Accumulation Chamber – PAC) in grams of methane (CH4) per day per kg of feed eaten. A more positive value indicates higher emissions, a more negative value is desirable.

Table 13 shows less methane emitted than zero gCH4/day/kg feed eaten, compared to more methane emitted than zero gCH4/day/kg feed eaten. *Note the average for these sires is 0.270gCH4/day/kg feed eaten, so even if the bar is red (more than zero), it may still be less than the average for the cohort, the dots indicate above-average and below-average for this cohort.*

Table 13. 2021-cohort methane PAC breeding values by sire, generated by Single Step NZGE 23 September 2022

Sire Birth ID	PACCH4 gBV (g CH4/day)
228.136/18	
630.223/16	
712.5203/04	
845.200/19	
1425.620/16	
1811.1146/19	
1973.56/19	
2191.200/10	
2629.1173/19	
2744.51470/19	
2749.2309/19	
2759.7569/16	
3579.191661/19	
3855.FR1999/19	
4851.623/19	
4949.2128/18	
4989.563/19	



For reference looking at Table 13, sire 630.223/16 had the lowest methane output of the rams tested, represented by the teal index value bar. However, sire 845.200/19, even with a red index bar (indicating a breeding value more than zero), he is still below industry average, represented by the green dot.

The methane breeding values show variation amongst individuals and results indicate there are sufficient differences amongst individuals for a selection of sires based on their methane emissions.

Residual Feed Intake

Residual feed intake (RFI) is a measure of feed efficiency. Having a feed efficient animal is cost-effective and considered to be an important sustainability trait as the environmental focus on farming increases both nationally and internationally.

As mentioned above, for this trial, it was decided that methane emissions should be included on animals both grazing pasture and during feed efficiency measures whilst being fed lucerne pellets.

In July 2022, a total of 205 2021-cohort ewe hoggets – approximately 12 progeny per sire (n=17) – were measured for RFI at the Invermay Feed Intake Facility.

These animals had previously been PAC measured and rumen sampled off grass at Orari Gorge in May 2022.

Ewe hoggets were adjusted to the facility and the lucerne pellets over 14 days prior to the beginning of the measurement/test period. Over the 42-day test period, the following was undertaken:

- Daily feed intake was recorded,
- Liveweight was measured twice a week,
- subcutaneous fat depth was measured using ultrasound at the start and end of the test period, and
- methane emissions were measured using portable accumulation chambers.

Figure 10. 2020-cohort ewe hoggets eating lucerne pellets in the feed intake units at AgResearch Invermay in Mosgiel.

Compared with the 2019-cohort lambs, where there were issues with lambs from a particular sire struggling to adjust to eating within the facility, there were a couple of lambs that were slow to adjust, they were from different sires but there was no trend for progeny from particular sires to be particularly slower to adjust than others.

The 2021-cohort again demonstrated variable rates of feed intake across a range of liveweights.

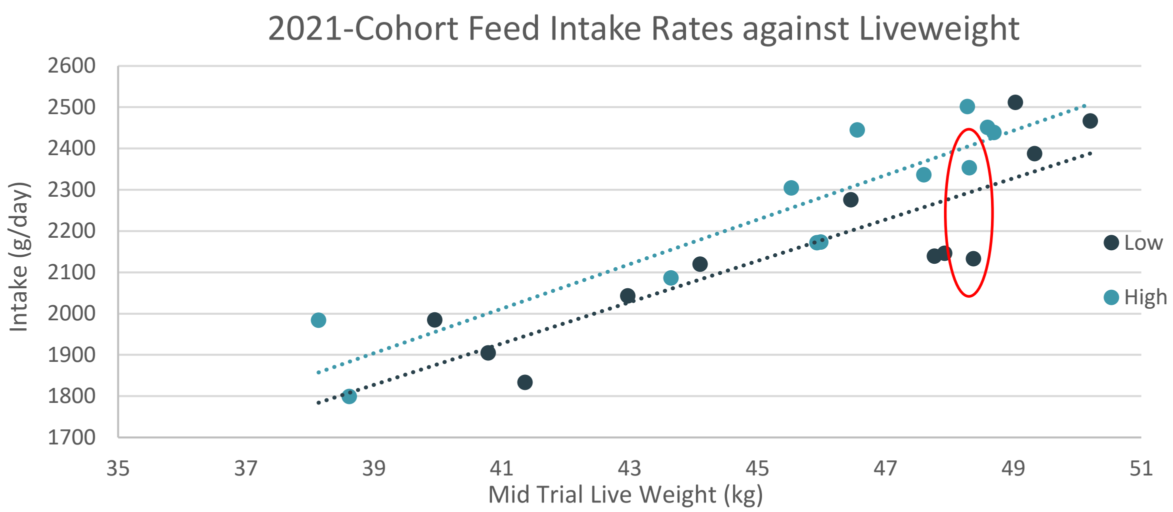


Figure 11. Plot demonstrating the variation in intake for given live weights for progeny from sires identified as high residual feed intake (eating more than expected) and low residual feed intake (eating less than expected). Note the red ring identifying two animals at the same weight with different intakes.

Feed efficiency can be calculated several ways. The most common approach is that described as the trait of Residual Feed Intake (RFI). Residual Feed Intake is estimated by determining a model that estimates how much the mob of animals is eating to maintain their live weight and to grow. This model is then used to determine how much an individual lamb should be eating given its live weight and growth rate, the actual amount that the animal is eating is then subtracted from the predicted number – if the number is positive it means that the animal is eating more than the model predicted it should need to eat, and if the number is negative it means that the animal is eating less than the model predicted it should need to eat.

Individual residual feed intake values were used to estimate sire variation in RFI.

Results – 2021 cohort

- The average feeding rate was 0.34 g/sec.
- The average intake was 110.5 g/feed.
- The average count of feeding events per day was 22.3 with an average duration of 323.7 seconds.
- The average weight gain over the trial was 14 kg (350 g/day liveweight).
- Subcutaneous fat depth increased on average by 1.8mm over the trial.

Table 14. 2021-cohort ewe hogget sire adjusted means calculated using the Mixed Procedure in SAS, for adjusted RFI during the RFI measurement period

Sire Birth ID	RFI adjusted (g/day)
228.136/18	
630.223/16	
712.5203/04	
845.200/19	
1425.620/16	
1811.1146/19	
1973.56/19	
2191.200/10	
2629.1173/19	
2744.51470/19	
2749.2309/19	
2759.7569/16	
3579.191661/19	
3855.FR1999/19	
4851.623/19	
4949.2128/18	
4989.563/19	

Wool/ fleece traits

In early December 2022, all retained 2021-cohort females had several fleece related traits recorded.

On 7th December 2022, 503 2021-cohort ewe hoggets had:

- Liveweight at 15 months taken (average liveweight = 55.5 kg).
- Side samples taken.
    - A side sample is where a small patch of wool is shorn from the side (near the hipbone) and given a colour score (average colour score = 3.0)[5] then sent to SGS (Timaru) for further analysis. These later returned an average micron of 34µm.
    - Breech and belly bareness characteristics scored. Breech bareness had an average score of 1.4 across the group while belly bareness score averaged 1.2[6].

Figure 12. A ewe hogget showing a relatively clear breech, score 4.

On 15th December 2022, these ewes were shorn and had their fleeces weighed. The average fleece weight was 2.4kg.

Table 15. Wool quality measures for 2021-cohort ewe hoggets.

Wool Quality Measure	**Average** (µm)	**Min** (µm)	**Max** (µm)
Fibre Diameter (µm)	34.0	20.5	45.3
Standard Deviation of average Fibre Diameter	9.4	5.4	13.8
Coefficient of variation of average Fibre Diameter	27.7	19.2	38.2

- Index merit of 2021-cohort sires **within-flock** (derived from a newer evaluation than those listed above, **run 40217, 26 Jan 2023**).
  Within Flock Traits (Better than average for trait, lower than average for trait).
    - **DPW** – Dual Purpose Wool Index, in cents per ewe lambing, includes fleece weight taken at 12 months of age.
    - **DPBP** – Dual Purpose Bare Points Index, in cents per ewe lambing, includes breech and belly bareness.
- NZGE derived merit - information generated by NZGE, not within flock analysis.
  Wool quality merit is across-flock, generated by **NZGE analysis 40160(v3), 20 Jan 2023.**
    - **DPWQC** – Dual Purpose Wool Quality Colour Index, in cents per ewe lambing, includes visual wool colour.
    - **DPWQF** – Dual Purpose Wool Quality Fineness Index, in cents per ewe lambing, includes fibre diameter.

[5] Colour score is measured on a scale of 1 to 5 where 1 is white and 5 is yellow.

[6] Breech and belly bareness scores are measured on a scale of 1 to 5, where 1 is covered in wool, and 5 is bare of wool.

There is significant breed variation in this trial. It is of note that there was a Finn sire in this cohort, and as Table 16**Error! Reference source not found.** describes, these have low DPW and high DPBP as the ewes will have shed part of their fleeces.

Breed compositions on each cohort's individual sires can be found in Appendix 1.

*Table 16. **Within flock** genetic merit for **wool and bare points** traits for 2021-cohort sires (derived from run 40217, 26 Jan 2023). ***Across flock** genetic merit for **wool quality colour and fineness**, generated by NZGE analysis 40160 -V3, 20 Jan 2023) not within flock.*

SIL Bth Id	Within Flock		*NZGE	
	DPW (cents)	DPBP (cents)	*DPWQC (cents)	*DPWQF (cents)
228.136/18				
630.223/16				
712.5203/04				
845.200/19				
1425.620/16				
1811.1146/19				
1973.56/19				
2191.200/10				
2629.1173/19				
2744.51470/19				
2749.2309/19				
2759.7569/16				
3579.191661/19				
3855.FR1999/19				
4851.623/19				
4949.2128/18				
4989.563/19				

DATA SUMMARY – 2022 COHORT

Mating & Pregnancy Scanning

In November 2021, expressions of interest were opened to the industry to nominate flocks for consideration in the 2022-cohort mating of the Low Input Progeny Test.

A total of 56 flocks expressed interest in submitting a sire to the trial, reiterating the growing public interest in the project felt from this year's field day and previous events. The Low Input Steering Group along with B+LNZ Genetics, met in mid-December 2021 to discuss the merit of each nomination and ultimately decide on which to include.

When nominations opened, a forward to the application detailed that as a driver for industry change, preference would be given to flocks currently recording "Low-input traits" in their own flocks. "Low-input traits" include, but are not limited to, dag score, parasite resistance, bareness, tail traits, and methane. This formed a major part of the criteria for selection alongside genetic connectedness in SIL.

As a result of these expressions of interest, 15 industry flocks were selected, including three flocks which have not entered rams into this trial previously.

A further two rams were allocated as link sires[7], totalling 17 sires (all HD genotyped by GenomNZ) to produce the 2022-cohort. A full list of all cohort sires can be found in Appendix 1 - Rams used in 2019, 2020, 2021 & 2022 Cohorts.

In addition to this, the mating was split between natural mate and AI sires.

Table 17. Breakdown of 2022-cohort mating by mating method, ewe age, body condition score and liveweight at mating.

Mating Method	# Mixed Age Ewes	# 2019bn Ewes	# 2020bn Ewes	TOTAL
AI	234	181	58	473
Natural Mate	158	85	405	648
Average BCS	2.9	2.8	3.5	3.1
Average Mate Weight	60.3	54.1	55.1	56.7
Total	**392**	**266**	**463**	**1121**

1455 ewes in total were weighed and body condition scored (BCS) in March 2022. An average liveweight across these ewes of 56.4kg was recorded alongside a 2.9 average BCS. This was lighter than anticipated which resulted in the removal of a number of ewes from the trial.

Anything under 45kg or a BCS of 2 was removed from the trial and was not programmed to undergo artificial insemination (AI) or available for the natural mate programme.

A total of 1121 ewes were mated, as per Table 17.

8 sires including both a year link and site link were mated to 473 ewes via AI over two days in April, and a further 9 sires naturally mated 648 ewes in four mate groups for 1 cycle (17days).

[7] Link sires provide genetic connections across flocks and/or years which benefit the accuracy of genetic information.

Pregnancy scanning of the 2022-cohort mated trial ewes was carried out by Daniel Wheeler, one of our steering group breeders in June.

The 473 AI ewes scanned a 75% conception rate while the 648 naturally mated ewes scanned at 72% conception, giving an overall conception of 74%.

The AI ewes scanned 132% (number of foetuses to ewes mated) and the naturally mated ewes scanned 134%, giving an overall scanning percentage of 134% for the 2022-cohort. For reference the 2020-cohort scanned approximately 131% and the 2021-cohort approximately 141%.

Docking/Tailing

The ewes mated to the 2022-cohort sires were pregnancy scanned and split into seven mobs: one mob of singles, five mobs of twins and one mob of triplets and set stocked for lambing.

In early October, a team of Orari Gorge farm staff, B+LNZ Genetics, contract and casual staff set out to dock/tail the progeny test 2022-cohort lambs. 1122 lambs were present at docking, 590 females and 532 males.

The cohort has achieved 100% lambs docked/tailed to ewes mated, or 135% lambs docked/tailed to ewes scanned pregnant.

Once drafted from the ewes, lambs were tagged with an Electronic ID tag and a tissue sample for DNA parentage was taken using a tissue sampling unit (TSU). The animal's tag, TSU, sex and tail traits were recorded including length of tail, length of skin under tail (Figure 13. Example of how to measure tail skin length.) and length of leg (hock to anus). The tail traits can vary between breeds and are recorded to establish the relationship between the bareness and length of tail and an animal's propensity to form dags.

Ewe lambs have their tail docked, the male lambs do not. At this time, males are also turned in to cryptorchids.

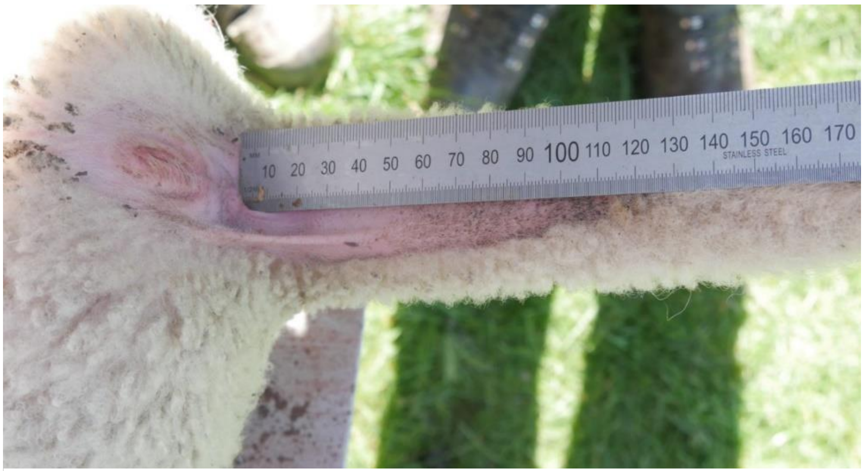


Figure 13. Example of how to measure tail skin length.

Table 18 describes the variation in the raw tail measures.

Table 18. Tail measures recorded for the 2022-cohort lambs.

Measurement	Average	Minimum	Maximum
Tail Skin Length (mm)	86.0	30	210
Tail Length (mm)	216.9	80	320

Table 18 demonstrates the variation between sires for tail length traits. Table 19 demonstrates the variation between sires for tail length traits. It is important to note here the ability of the sire to impact their progeny. As most of the flocks these sires are from have not been selected for these traits, what is being demonstrated is the variation between the sires.

- Index merit of 2022-cohort sires **within-flock** (derived from a newer evaluation than those listed above, **run 40217, 26 Jan 2023**).
    - **TLENSCrBV –** tail length score research breeding value is converted from the raw measurement in centimetres to a 3-point tail length score (1-short<15cm, 2-medium 15-25cm, 3-long >25cm). A more positive value indicates longer tail length, a more negative value is desirable. Shorter than average tail length, longer than average tail length.
    - **TSKINrBV –** tail bare skin length research breeding value estimates length of bare skin area on the underside of the tail. A more positive value indicates longer tail bare skin length. Longer than average bare skin length under tail, shorter than average bare skin length under tail.

Table 19. Within flock genetic merit for tail traits for 2022-cohort sires, (derived from run 40217, 26 Jan 2023).

Sire Birth ID	TLENSC rBV (score)	TSKIN rBV (cm)
228.538/20		
480.558/20		
1425.908/20		
1811.1146/19		
1839.926/20		
1941.191929/19		
1973.405/20		
2351.W53/19		
2501.348/21		
2744.50652/19		
2749.1974/16		
3001.3303/19		
4474.197/20		
4548.3243/19		
4851.924/20		
4949.2108/19		
4989.217/20		

Weaning

1055 lambs were weaned on the 8/12/22: 559 ewe lambs averaging 21.4 kg and 501 male lambs averaging 23.3 kg. Both sexes were on average around 1kg back on last year despite weaning at roughly the same age.

DNA parentage was returned prior to weaning to determine their sire match. Those not returning a full DNA match were marked as control animals and run within the same contemporary groups (though not genetically comparable).

At weaning all lambs were drenched and run as separate mobs (male and ewe lambs) after weaning.

Lambs were scored on their propensity to form dags at weaning, the average score was 0.22 across both sexes, which is slightly less than last year's average at weaning[8].

Ewes were weighed and body condition scored (BCS) at mating and again at weaning.

At mating, 1455 ewes weighed an average of 56.4 kg with a BCS of 2.9. At weaning, those ewes which produced a lamb on average weighed 55.4 kg with a BCS of 3.0 and a dag score of 1.3.

[8] Dag score is measured on a scale of 0 to 5, where 0 is no dag and 5 is very daggy.

OVERVIEW OF 2019, 2020 & 2021 COHORTS

The following details raw trait averages across the 2019, 2020 and 2021 cohorts.

Growth

Table 20 describes the raw trait averages across the three cohorts of the trial for liveweight growth traits.

Table 20. Comparison of data averages from across the three years for growth measures.

Measurement	Year of Birth (cohort)					
	2019		2020		2021	
	Male	Female	Male	Female	Male	Female
Weaning Weight (kg)	27.4	25.1	28.5	26.0	24.7	22.6
Liveweight at 6 months of age (kg)	36.8	31.0	33.3	30.3	29.5	29.8
Liveweight at 8 months of age (kg)	40.1	34.6	40.5	34.6	41.7	33.2

Faecal egg counts (FEC)

Table 21 describes the raw trait averages across the three cohorts of the trial for FEC traits.

Table 21. Comparison of data averages from across the three years for FEC measures.

Measurement	Year of Birth (cohort)					
	2019		2020		2021	
	Male	Female	Male	Female	Male	Female
FEC 1 - faecal egg count prior to March (eggs per gram)	465	1611	940	539	3157	732
FEC 2 - faecal egg count after March (eggs per gram)	2480	734	-	1404	-	4437

Dag Scoring

Table 22 describes the raw trait averages across the three cohorts of the trial for dag score traits.

Table 22. Comparison of data averages from across the three years for dag score measures. Note – Male lambs have long undocked tails, and female lambs are docked at tailing/docking.

Measurement	Year of Birth (cohort)					
	2019		2020		2021	
	Male	Female	Male	Female	Male	Female
Dag Score at 3 months of age	0.88	0.61	0.34	0.25	0.37	0.29
Dag Score at 8 months of age	2.0	1.53	2.48	1.50	1.73	2.55

Eye muscle scanning

Table 23 describes the raw trait averages across the three cohorts of the trial for ultrasound measurements.

Table 23. Comparison of data averages from across the three years for ultrasound measures and associated liveweight.

Measurement	Year of Birth (cohort)		
	2019	2020	2021
Liveweight at muscle scanning (kg)	44.6	44.4	41.8
Eye muscle depth (mm)	24.5	25.7	25.1
Eye muscle width (mm)	62.0	66.8	64.3
Fat depth (mm)	3.3	2.9	3.5

Lamb slaughter

Table 24 describes the raw trait averages across the three cohorts of the trial for carcass measurements obtained from the plant through VIAscan.

Table 24. Comparison of data averages from across the three years for carcass measures and associated liveweight.

Measurement	Year of Birth (cohort)		
	2019	2020	2021
Pre-slaughter liveweight (kg)	44.5	40.6	41.7
Hot carcass weight (kg)	19.4	17.7	17.4
VIAscan GR fat (mm)	4.8	3.7	6.3
VIAscan yield (%)	55.34	55.13	53.2

Hogget Oestrus

Table 25 describes the raw trait averages across the three cohorts of the trial for hogget oestrus.

Table 25. Comparison of data averages from across the three years for hogget oestrus measurements.

Measurement	Year of Birth (cohort)		
	2019	2020	2021
% marked <35kg	31%	36%	41%
% marked 35-39kg	60%	63%	71%
% marked 40-50kg	82%	85%	87%
Total Oestrus %	60%	67%	62%

Residual Feed Intake

Table 26 describes the raw trait averages across the three cohorts for measures captured during residual feed intake.

Table 26. Comparison of data averages from across the three years during the Residual Feed Intake trials.

Measurement	Year of Birth (cohort)		
	2019	2020	2021
Feeding rate (g/sec)	0.36	0.38	0.34
Mid Trial Intake (g/day)	2404.8	2539.8	2181.6
Number of feeding events per day/duration (count/s)	29/98	22.8/303	22.3/323.7
Weight gain (kg)	17.7	13.8	14
Subcutaneous fat depth increase (mm)	2.5	1.9	1.8

Wool/ fleece traits

Table 27 describes the raw trait averages across the three cohorts of the trial for fleece traits and accompanying liveweight.

Table 27. Comparison of data averages from across the three years for fleece measures.

Measurement	Year of Birth (cohort)		
	2019	2020	2021
Liveweight 12-15 months of age (kg)	Not recorded	55.3	55.5
Wool Colour Score	2.2	2.7	3.0
Breech Bareness	2.0	1.5	1.4
Belly Bareness	1.2	1.3	1.2
Fleece weight at 12-15 months of age (kg)	2.5	2.4	2.4
Average fibre diameter (µm)	33.7	32.1	34

ACTIVITIES UNDERTAKEN

EXTENSION

Overview:

- The field day was completed in November 2022.
    - On-farm field day video recording

Field day

The final field day for this project was held on 23 November 2022 at Orari Gorge Station to share insights from the trial and information for farmers wanting to incorporate low input traits into their flocks.

Prior to the field day, a report was circulated to participating breeders documenting within-flock breeding values as well as raw data for 2019, 2020 and 2021-cohort results (see links listed above).

There were 60 physical attendees (55 registrations) and 25 virtual attendees (50 virtual registrations) with over 260 views of the recording as at end of December 2022.

During the field day, we heard from:

- Robert Peacock, the on-farm manager of the Low Input Progeny Test at Orari Gorge Station, who shared his experiences and insights whilst managing the animals of this project,
- Suzanne Rowe, Senior Scientist at AgResearch, on the impact of methane emission measures and progress made in the estimation of breeding value for this trait,
- Patricia Johnson, Senior Scientist at AgResearch, on feed efficiency and the variation of feeding behaviour both across the cohort groups and within sire lines,
- Patricia Johnson, also spoke on the role genetics has to play in short tails and bare "bums and tums",
- Kathryn McRae, Senior Scientist at AgResearch on breeding sheep that are more resistant to disease, including internal parasites and pneumonia,
- Ginny Dodunski, on advice for on-farm management of parasites in the age of multi-drench resistance, and
- Sharon McIntyre, on key low input traits and what this trial has shown us in terms of the combination of genetics and management on performance.

Robust discussion and interaction from the participants following the presentations occurred, along with questions in the Q&A portal throughout the presentations.

The field day concluded with the group viewing the 2022-cohort of lambs and their dams, along with the 2021-cohort ewe hoggets.

It was reiterated by Robert Peacock that breeders need to be measuring and commercial farmers need to be asking their ram sources to measure low input traits such as worm resistance and dags, as these are important traits for the "sheep of the future".

IN PROGRESS / UPCOMING MEASUREMENTS

2022-cohort

- Liveweights
- WormFEC
- Eye muscle scanning
- Lamb slaughter
- Hogget oestrus
- Methane
- Fleece weight and wool quality
- Bare points

2021-cohort

- Mate weight
- Mate BCS
- Pregnancy Scanning
- Lambing
- Docking
- Weaning

APPENDIX

Appendix 1 - Rams used in 2019, 2020, 2021 & 2022 Cohorts

Table 28. 2019-cohort sire flocks and breed compositions. Grey highlights the across year and across flock link sires to CPT.

Sire Birth ID	Sire Cur ID	Birth Flock	Breed1	Breed2	Breed3
151.G197/14	151.G197/14	Kikitangeo	Rom		
228.25/16	228.25/16	Wheeler	Finn		
1072.737/17	1072.737/17	Newhaven	Peren		
1425.209/17	1425.209/17	Nikau	Coop		
1811.54/17	1811.54/17	Orari Gorge	Rom		
1811.606/17	1811.606/17	Orari Gorge	Rom		
2368.7165/17	2351.7165/17	Richwilt	Wilt		
2629.1020/17	2629.1020/17	Nithdale	Rom	Texel	
2744.50985/17	2744.50985/17	Kelso Maternal	Comp	Texel	Finn
2744.51137/16	2744.51137/16	Kelso Maternal	Texel	Finn	Coop
3666.383/17	3666.383/17	Ardo Eazicare	PolDor	Texel	TexX
4480.3167/17	4480.3167/17	Ngaputahi Glen Growbulk	Rom	Texel	PolDor
4548.3049/15	4548.3049/15	Avalon Ultimate	Texel	Peren	Finn
4591.9506/15	4591.9506/15	Waipuna Highlander	Highlnd	Rom	
4626.2318/15	4626.2318/15	Avalon Texel	Texel	Texel	Peren
4851.75/17	4851.75/17	Romani	Coop	Rom	
4989.282/17	4989.282/17	Readstock	Comp	Wilt	

Table 29. 2020-cohort sire flocks and breed compositions. Grey highlights the across year and across flock link sires to CPT.

Sire Birth ID	Sire Cur ID	Birth Flock	Breed1	Breed2	Breed3
124.123/17	124.123/17	Moutere Downs	Rom		
480.294/18	480.294/18	ARDG	Rom		
1425.633/17	1425.633/17	Nikau Coopworths	Coop		
1811.606/17	1811.606/17	Orari Gorge Romneys	Rom		
1941.160910/16	1941.160910/16	Raupuha	Peren		
1973.548/18	1973.548/18	Melrose	Corrie	PollMer	
2629.993/18	2629.993/18	Nithdale	Rom	Texel	
2744.50705/18	2744.50705/18	Kelso Maternal	Rom	Texel	Finn
3422.C362/15	3422.C362/15	Blackdale Coop Texel	Texel	Coop	Comp
4548.3444/17	4548.3444/17	Avalon Ultimate	Texel	Peren	Wilt
4591.1844/18	4591.1844/18	Waipuna Highlander	Highlnd	Rom	
4741.MUL777/18	4741.MUL777/18	Wairere Multipliers	Comp	TEFR	
4851.717/18	4851.717/18	Romani	Coop		
4949.2128/18	4949.2128/18	Orari Gorge RomTex	Rom		
4969.207/18	4969.207/18	Wheeler Meat	Texel	Finn	Dama
4989.160/18	4989.160/18	Readstock	Comp		

Table 30. 2021-cohort sire flocks and breed compositions. Grey highlights the across year and across flock link sires to CPT.

Sire Birth ID	Sire Cur ID	Birth Flock	Breed1	Breed2	Breed3
228.136/18	228.136/18	Wheeler	Finn		
630.223/16	630.223/16	ARDG - Glenbrook	Rom		
712.5203/04	2415.M5203/04	Marlow	Coop		
845.200/19	845.200/19	Avalon	Peren		
1425.620/16	1425.620/16	Nikau	Coop		
1811.1146/19	1811.1146/19	Orari Gorge Romneys	Rom		
1973.56/19	1973.56/19	Melrose	PollMer	Corrie	Merino
2191.200/10	2191.200/10	Motu-nui Romneys	Rom		
2629.1173/19	2629.1173/19	Nithdale	Rom	Texel	
2744.51470/19	2744.51470/19	Kelso Maternal	Rom	Texel	Highlnd
2749.2309/19	2749.2309/19	Mount Linton	Rom	Texel	Romdale
2759.7569/16	539.7569/16	Wairere Romney	Rom		
3579.191661/19	3579.191661/19	HWNZ Elite Ewe Flock	Comp		
3855.FR1999/19	3855.FR1999/19	FG Freestone	Rom	Highlnd	Finn
4851.623/19	4851.623/19	Romani	Coop	Rom	
4949.2128/18	4949.2128/19	Orari Gorge RomTex	Rom		
4989.563/19	4989.563/19	Readstock	Comp	Wilt	

Table 31. 2022-cohort sire flocks and breed compositions. Grey highlights the across year and across flock link sires to CPT.

Sire Birth ID	Sire Cur ID	Birth Flock	Breed1	Breed2	Breed3
228.538/20	228.538/20	Wheeler	Finn	Texel	Coop
480.558/20	480.558/20	ARDG - Alexander Farming	Rom		
1425.908/20	1425.908/20	Nikau	Coop		
1811.1146/19	1811.1146/19	Orari Gorge Romneys	Rom		
1839.926/20	1839.926/20	Pahiwi	Rom		
1941.191929/19	1941.191929	Raupuha	Peren		
1973.405/20	1973.405/20	Melrose	Corrie	PolMer	Merino
2351.W53/19	2351.W53/19	Romani - Richwilt	Wilt		
2501.348/21	2501.348/21	Forrester	Ile de France	PolDor	Dorset Horn
2744.50652/19	2744.50652/19	Kelso Maternal	Texel	Comp	Finn
2749.1974/16	2749.1974/16	Mount Linton	Rom	Texel	
3001.3303/19	3001.3303/19	Focus Genetics Goudies	Rom		
4474.197/20	4474.197/20	Twin Farm	Romney	Texel	EastFr
4548.3243/19	4548.3243/19	Avalon Ultimate	Texel	Peren	Finn
4851.924/20	4851.924/20	Romani	Coop	Rom	
4949.2108/19	4949.2108/19	Orari Gorge RomTex	Rom	Texel	
4989.217/20	4989.217/20	Readstock	Comp	Wilt	

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