beef+lamb new zealand GENETICS

Low Input Sheep Progeny Test

PROJECT: Ethically and sustainably produced, high-value lamb

Public Report

September 2021

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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 two cohorts of lambs (born in 2019 and 2020) so far and has recently completed mating to produce its third and final cohort (2021-cohort). A full list of each cohort's sire flocks and breed compositions is listed in Appendix 1.

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), carcase 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 this trait.

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 only covers the two 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 selection decisions, B+LNZ Genetics recommends using all available information (NZGE) to get the most complete estimates of genetic merit.

DATA SUMMARY – 2020 COHORT

Within Flock Index Merit 2020-Cohort

The Table1. Index merit of 2020-cohort sires within-flock**. *Methane merit is generated by NZGE analysis 38574, July 2021**is based on a within-flock evaluation using data from the Low Input Progeny Test Flock (5010) only.

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 2020 (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 on the following page 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 very low 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 and liveweight 6.
  - **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.
  - **Tail length** – tail length 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). Shorter than average tail length, longer than average tail length.
  - **Tail Skin** – tail bare skin length research breeding value is represented in centimetres. 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** – PAC methane emission genomic breeding value estimates methane emitted in grams of methane (CH_4) per day. A more positive value indicates higher emissions, a more negative value is desirable.
    Note this has been reversed in Table1 below to show less methane emitted than average compared to more methane emitted than average.

*Table1. Index merit of 2020-cohort sires within-flock. ***Methane merit is generated by NZGE analysis 38574, July 2021***

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	SGMDF (cents)	GMDF (cents)	DPS (cents)	DPG (cents)	DPM (cents)	DPD (cents)	DPF (cents)	Tail Length (score)	Tail Skin (cm)	Methane* (g CH4/day)
124.123/17										
480.294/18										
1425.633/17										
1811.606/17										
1941.160910/16										
1973.548/18										
2629.993/18										
2744.50705/18										
3422.C362/15										
4548.3444/17										
4591.1844/18										
4741.MUL777/18										
4851.717/18										
4949.2128/18										
4969.207/18										
4989.160/18										

Mating

COVID-19 saw a change to the initial mating plan to produce the 2020-cohort.

Originally a full AI programme was planned for roughly 1000 ewes, however this eventuated into a partial AI programme for 300 ewes utilising 6 industry sires, and a natural mating programme for the remaining 700 ewes where another 10 industry sires were used.

Natural mating took place over 10 days starting on 15/04/20, AI was over 2 days on 15 & 16/04/20. On average at mating ewes weighed 58kg with a BCS of 3.02, this is marginally lighter in both weight and condition than last year.

A list of the sires used to produce the 2020-cohort can be found in Appendix 1.

Figure 2. 2019-cohort ewes setting off for set stocking at Orari Gorge Station.

Pregnancy Scanning

AI ewes were pregnancy scanned on 9/06/20 and the naturally mated ewes on 19/06/20.

AI conception rate for the 2019 cohort was roughly 72% whereas the 2020 cohort is approximately 84% for the 300 ewes which underwent AI. This is an outstanding rate and a credit to Robert and his team for stepping up in the face of the challenge of COVID-19. The remaining naturally mated 2020-cohort ewes saw a 70% conception rate.

The overall pregnancy scan rate for the 2019-cohort was approximately 157%[1]. Of the 2020-cohort, an overall pregnancy scan rate of 176% was achieved, with a rate of 168%[1] achieved by the AI'd ewes and 180%[2] for the naturally mated ewes.

Lambing

The ewes mated to the 2020-cohort sires were pregnancy scanned and split into four mobs, one mob of singles, two mobs of twins and one mob of triplets and set stocked for lambing.

As lambs were born, the twin mobs were shedded so that any ewes yet to lamb were moved into another paddock on the 16th September 2020, creating a third twin mob.

[1] number of foetuses to ewes conceived to AI

[2] number of foetuses to ewes conceived to natural mating

Docking/Tailing

On the 1/10/20, a large team of Orari Gorge farm staff, B+LNZ Genetics, contract and casual staff set out to dock/tail the progeny test 2020-cohort lambs. 1127 lambs were present at docking, 565 females and 562 males.

Figure 3. Setting up at a docking location, a beautiful South Canterbury day with lots of 2020-cohort lambs.

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 12) 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 4. Example of how to measure tail skin length.

Tail length is highly heritable, but in the Romney breed there is little variation in tail length. As the ewe base is Romney, the variation in tail length will be predominantly from the sires.

Some breeds such as Finn, Dorper and Texel generally have shorter tails. Tail traits were recorded at docking on 1/10/2020. Tail length was recorded with a ruler from the base of the tail to the tip, clear skin area is also recorded with a ruler.

Tail length varied from 13cm to 31cm, averaging 21.9cm.

Table 2. Average tail length and length of bare skin area on the underside of the tail in all 2020-cohort lambs measured at docking/tailing.
Note - Q1 and Q3 represent the 25th and 75th percentile bands – 50% of the animals fit between these two values.

Tail Trait	Average	Minimum	Q1	Q3	Maximum
Tail Length (cm)	21.9	13	20	24	31
Tail Bare Skin Length (cm)	8.2	2	6	10	18

Table 3 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.

- **Tail length** – tail length 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). Shorter than average tail length, longer than average tail length.
- **Tail Skin** – tail bare skin length research breeding value is represented in centimetres. 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 2020-cohort sires, scaled to the corrected progeny mean.

Sire Birth ID	Tail Length (score)	Tail Skin (cm)
124.123/17		
480.294/18		
1425.633/17		
1811.606/17		
1941.160910/16		
1973.548/18		
2629.993/18		
2744.50705/18		
3422.C362/15		
4548.3444/17		
4591.1844/18		
4741.MUL777/18		
4851.717/18		
4949.2128/18		
4969.207/18		
4989.160/18		

Weaning

Ewes were lambed in five mobs: singles, three mobs of twins and one mob of triplets. 1103 lambs were weaned on the 8/12/20: 554 ewe lambs averaging 26.0 kg and 548 male lambs averaging 28.5 kg. Both sexes average around a kilo more than 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 sire match (~60) were marked as control animals and run within the same contemporary groups (though not genetically comparable) and were drenched approximately monthly. These were born roughly 10 days later than the average birth date of the main cohort.

At weaning all lambs were drenched, dipped and run as separate sexed mobs after weaning. The male lambs with long tails were not crutched at this time as they were in the 2019-cohort.

Lambs were scored on their propensity to form dags at weaning, the average score was 0.25 across both sexes, which is considerably less than last year's average at weaning of 0.75[3].

Ewes were weighed and body condition scored (BCS) at mating and again at weaning. At mating, 1135 ewes weighed an average of 58.0 kg with a BCS of 3.0. At weaning, those ewes which produced a lamb on average weighed 62.7 kg with a BCS of 3.0 and a dag score of 1.9. These scores are a great indication of how well these ewes were maintained from mating, throughout pregnancy to weaning.

Figure 5. Ewes and lambs of 2020-cohort prior to weaning.

Growth

Further to weaning weight, liveweights were recorded monthly on both sexes of the 2020-cohort lambs post weaning, alongside other measurements.

Post-weaning, lambs were grazed in single-sex mobs, remained undrenched and uncrutched until slaughter (males only) and were dipped again in late January.

As mentioned previously ewe lambs had their tail docked, the male lambs were left undocked but were turned in to cryptorchids.

Table 4. Average liveweights (kg) for both sexes pf the 2020-cohort lambs measured.
WWT – weaning weight, LW6 – liveweight at 6-months of age, LW8 – liveweight at 8-months of age.
Note - Q1 and Q3 represent the 25th and 75th percentile bands – 50% of the animals fit between these two values.

Sex	Weight Record	Number of animals	Mean (kg)	Min (kg)	Q1 (kg)	Q3 (kg)	Max (kg)
Males	WWT	548	28.5	14.8	25.8	31.2	41.2
	LW6	546	44.3	25.2	41.4	47.6	57.8
	LW8	545	40.1	22.2	37.4	43.0	52.0
Females	WWT	555	26.0	13.6	23.8	28.4	40.4
	LW6	553	36.6	24.6	34.0	39.4	46.6
	LW8	550	35.1	23.4	32.4	38.0	47.0

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

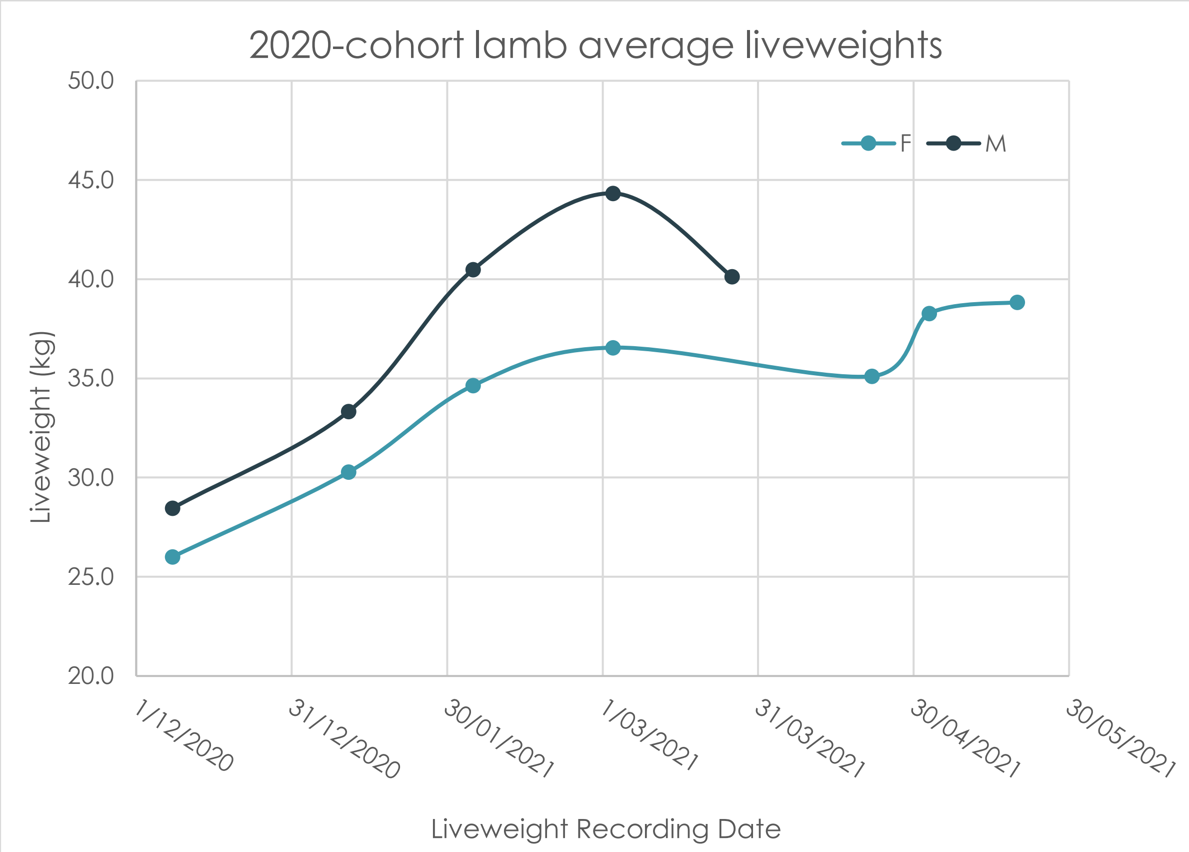

Figure 6. Liveweights of 2020-cohort lambs from weaning (Dec 202) to June 2021. F= females, M=males

The males grew steadily from weaning in December at roughly 200g/day until March including a 300g/day growth spurt in January. During March, a sharp weight loss is observed where between the two March liveweights, on average male lambs lost 4.21kg.

The females saw a much more moderate growth rate of 125g/day from weaning to March, however they too saw weight loss between the March and April weights where on average, female lambs lost 1.44kg.

Contributing factors to the weight loss are described below:

- The 2020-cohort male lambs were crutched the days prior to the 26th of March weight and were at least 24 hours empty compared to the usual ~2 hours off grass prior to a liveweight measurement.
- Female lambs were docked, and all male lambs were left undocked. The long-tailed males saw much more dag accumulation on some lambs (see Figure 13) which contributed to a significant amount of weight.
- The female lambs were shorn between these two weigh dates.

Figure 7. 2020-cohort male lambs at muscle scanning showing variation in dag accumulation.

In comparison to the controls, male control lambs saw a weight loss of half the amount of the trial male lambs. Female control lamb weight loss was approximately the same average weight loss as female trial lambs.

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

- **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 (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 5. Within flock genetic merit for growth traits for 2020-cohort sires, scaled to the corrected progeny mean.

Sire Birth ID	DPG (cents)	WWTeBV (kg)	LW8eBV (kg)
124.123/17			
480.294/18			
1425.633/17			
1811.606/17			
1941.160910/16			
1973.548/18			
2629.993/18			
2744.50705/18			
3422.C362/15			
4548.3444/17			
4591.1844/18			
4741.MUL777/18			
4851.717/18			
4949.2128/18			
4969.207/18			
4989.160/18			

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.

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 March 2021 and on all remaining lambs (females only) in May (Table 6).

Table 6. Average eggs per gram (epg) from female and male lambs in March and May recording events. Note - Q1 and Q3 represent the 25th and 75th percentile bands – 50% of the animals fit between these two values.

Sex	FEC Measure	Date	Number of animals	Mean (epg)	Min (epg)	Q1 (epg)	Q3 (epg)	Max (epg)
Females	FEC1	1/03/21	514	539	0	245	735	4165
	FEC2	13/05/21	488	1404	0	455	1715	15470
Males	FEC1	1/3/21	499	944	0	490	1225	5355

All 2020-cohort lambs received an oral drench at weaning. Male lambs then remained undrenched until they were slaughtered, and females received a drench mid-May.

Ewe lambs were grazed on clover near the end of February for roughly 10 days to assist with weight gain. The male lambs were also grazed on clover for two weeks however were finished off pasture prior to kill.

The ewe lambs averaged a much higher epg in May than in March, however an increase was expected as May is a known high exposure period for worms.

Animals are regularly monitored by farm staff with individuals displaying clinical symptoms of a high parasite burden such as rapid weight loss, excessive scouring are treated with drench immediately and removed from the trial. To date there has only been a small number of 2020-cohort lambs which have been treated and removed from the trial.

Figure 8. Orari Gorge team taking faecal samples off the 2019-cohort lambs

- **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.

Table 7. Within flock genetic merit for worm resistance for 2020-cohort sires, scaled to the corrected progeny mean.

Sire Birth ID	DPF (cents)
124.123/17	
480.294/18	
1425.633/17	
1811.606/17	
1941.160910/16	
1973.548/18	
2629.993/18	
2744.50705/18	
3422.C362/15	
4548.3444/17	
4591.1844/18	
4741.MUL777/18	
4851.717/18	
4949.2128/18	
4969.207/18	
4989.160/18	

It is important to note that within each sire shown in Table 7, there are a number of individuals which have been measured (some of them twice) with varied results.

Table 6 showed that at the FEC1 measurement taken in March on both sexes, a higher average was recorded in the males than in the females. This shows how sires can demonstrate variation in their progeny, even across a single measurement.

For the females measured twice, sires which have low FEC averages at both measures are superior as their progeny have shed less egg in total.

Note
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.

Dag Scoring

All lambs were scored (DAG3) at weaning in December 2020 and in March 2021 (DAG8). The average dag scores can be seen in Table 8.

As mentioned previously ewe lambs had their tail docked, the male lambs were left undocked but were turned in to cryptorchids.

Lambs were dipped for flystrike at weaning in December 2020 and then in late January 2021. Despite a major presence of dags in the male lambs, there were very minimal issues with flystrike.

Table 8. Average dag scores by sex.

Sex	Number of animals	DAG3 (score)	DAG8 (score)
Male*	548	0.34	2.48
Female	555	0.25	1.50

* Note: due to the presence of long tails in the male lambs, they demonstrated a higher tendency to form dags. This was not so obvious at the initial score (DAG3) but more prevalent at DAG8. Due to this, the scoring between females and males varied where the ewe lambs were scored more harshly than the males to accurately demonstrate variation. Therefore, male and female dag scores cannot be compared.

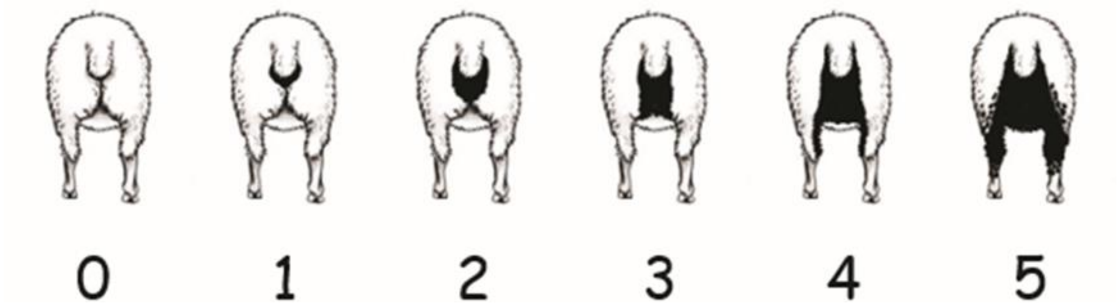

Figure 9. Dag Scoring scale used in the NZGE, where 0 represents no dags and 5 represents significant presence of dags.

Table 9.Incidence of progeny dag scores for males (long tails) in three increments, by 2020-cohort sires and control group.

Sire Birth ID	Dag score 0-1	Dag score 2-3	Dag score 4-5
124.123/17	28%	28%	44%
480.294/18	37%	19%	44%
1425.633/17	38%	34%	28%
1811.606/17	32%	55%	14%
1941.160910/16	14%	43%	43%
1973.548/18	27%	45%	27%
2629.993/18	27%	47%	27%
2744.50705/18	10%	29%	61%
3422.C362/15	20%	57%	23%
4548.3444/17	65%	31%	4%
4591.1844/18	7%	41%	52%
4741.MUL777/18	16%	61%	24%
4851.717/18	23%	39%	39%
4949.2128/18	33%	42%	25%
4969.207/18	24%	56%	20%
4989.160/18	55%	45%	0%
Control	51%	27%	22%

As shown in Figure 9 above, the higher the score, the higher the level of dagginess.
In Table 9, a higher incidence 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 (except the control group).

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

The control group males were left untailed and crypt, like the trial males, however received a drench toughly monthly.

Muscle scanning

547 male lambs were ultra-sound muscle scanned on 17th March 2021. 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. The control lambs who had been regularly drenched were slightly ahead of the trial lambs in all muscle measurements though slightly lighter in liveweight.

Table 10. 2020-cohort trial and control lambs average eye muscle scanning measurements.

Group	Number of animals	Average Liveweight (5/3/21)	Average EMD (mm)	Average EMW (mm)	Average FDM (mm)
Control	37	43.6	26.4	69.0	3.2
Trial males	510	44.4	25.7	66.8	2.9
Total	**547**	**44.3**	**25.8**	**66.9**	**2.9**

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 11on page 19 demonstrates the meat trait merit by both index and eBVs.

Lamb slaughter

Pre-slaughter live-weights of 545 male lambs of the 2020-cohort were taken on 26th March 2021. These ranged from 22 to 52kg with an average of 40.1kg. Twenty-two animals were removed from the kill line which weighed under 32kg, these have been removed from the Low Input Trial to the commercial flock.

The remaining 523 male lambs averaging 40.6kg liveweight were trucked to Alliance Smithfield in Timaru and processed on 29th March 2021.

Average hot carcass weight (HCW) was 17.7kg, ranging from 12.5 to 25.0kg. VIAScan GR fat measurements ranged from 1 to 10.8mm, and yields varied from 44.1 to 64% (excluding cutters[4]).

As the line was quite variable – so were the carcass parameters.

The main fault identified with the line was faecal contamination. This will be remedied next season by shearing prior to kill.

Shearing of lambs prior to slaughter does not align with the "Low Input" concept. However, due to the wool length and quality of these particular trial lambs, it has been made clear this

[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.

will be necessary for the plant to accept the lambs next season to avoid faults such as faecal contamination through processing.

A breeding programme which focusses on breeding for bare points may present opportunities to avoid this issue without shearing and maintaining a "Low Input" system.

- **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 2020-cohort sires, scaled to the corrected progeny mean.

Sire Birth ID	DPM (cents)	CWYeBV (kg)	LEANYeBV (kg)
124.123/17			
480.294/18			
1425.633/17			
1811.606/17			
1941.160910/16			
1973.548/18			
2629.993/18			
2744.50705/18			
3422.C362/15			
4548.3444/17			
4591.1844/18			
4741.MUL777/18			
4851.717/18			
4949.2128/18			
4969.207/18			
4989.160/18			

Methane

239 of the 2020-cohort ewe hoggets were selected and measured for methane on the 3rd – 5th of May 2021, on farm at Orari Gorge through the portable accumulation chamber (PAC) trailer. Ewes were allocated into groups with 12 animals per group with approximately 15 progeny per sire across the measures. In each case, lambs were allocated to each group to ensure that sires were represented across all three measurement days. All animals were weighed prior to being measured. Each ewe hogget was measured for 1 hour.

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

Table 12 describes the PAC methane emission genomic breeding values by sire.

- **PACCH4 gBV** – PAC methane emission gBV estimates methane emitted in g/day. A more positive value indicates higher emissions, a more negative value is desirable. Note this has been reversed in Table 12 below to show less methane emitted than average compared to more methane emitted than average.
  The below gBV information was generated by NZGE, not within flock analysis.

Table 12. 2020-cohort methane PAC breeding values by sire, generated by NZGE analysis 38574, July 2021.

Sire Birth ID	Methane (g/day)
124.123/17	
480.294/18	
1425.633/17	
1811.606/17	
1941.160910/16	
1973.548/18	
2629.993/18	
2744.50705/18	
3422.C362/15	
4548.3444/17	
4591.1844/18	
4741.MUL777/18	
4851.717/18	
4949.2128/18	
4969.207/18	
4989.160/18	

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.

It is important to note that most of the flocks these sires are from have not been selected for methane, therefore what is being demonstrated is the variation between the sires.

Methane is heritable, so a superior ram for reduced methane emissions can have an influence on your retained females. For example, the gBVs for the 16 sires in the 2019-cohort ranged from -0.87 to +1.4 grams CH_4 per day. If carbon was valued at NZ$100 per tonne and assuming a 25x warming potential for methane, we can estimate that this could amount to an $18 gross margin difference per ewe wintered between the highest and lowest ram.

Rumen sampling

Using oral stomach tubing, a sample of rumen fluid was collected from each of the 2020-cohort ewe hoggets on grass (n=239).

These samples are stored in preservative and their microbiome will be sequenced as part of another research project. Differences between sire rumen microbial composition for both the 2019 and 2020-cohort's will be provided back to the programme when they become available.

Figure 10. Rumen samples from 2020-cohort ewe lambs collected during methane measurements at Orari Gorge.

Hogget oestrus

Vasectomised (teaser) rams fitted with harnesses and crayons were joined with the 539 2020-cohort ewe lambs on 27th April and removed on 11th June 2021. This gave the ewes 45 days (roughly 2.5 cycles) to exhibit oestrus. Harness marks were checked and recorded at day 10, 24 and 45. Six two-tooth teasers ran with the ewes for the first 10 days, the six mixed age teasers replaced the two-tooth teasers and remained with the ewes until 11th June.

Approximately 67% of the ewe lambs demonstrated oestrus (were marked by the teasers) across the period, the remaining 33% were not marked.

Marked ewes had an average liveweight of 39.9kg, unmarked ewes recorded an average liveweight of 36.8kg.

Table 13. Number of marked and unmarked 2020-cohort ewe hoggets in weight brackets

Liveweight	Marked	Unmarked	Total	Oestrus %
<35kg	36	63	99	36%
35-39kg	142	84	226	63%
40-50kg	191	35	226	85%
Total	**369**	**182**	**551**	**67%**

Based on Table 13 above, it would be fair to assume that the heavier the weight, the more likely oestrus is to be exhibited. However, Table 14 on page 22 discredits this as there are sires represented by progeny at lower weights with higher incidences of oestrus. This demonstrates that there is a genetic component to hogget oestrus.

Table 14. Average liveweight of 2020-cohort ewe hoggets and the percentage which demonstrated oestrus by sire.*
* **Lower average weight**, **higher average weight.**

Sire Birth ID	Average weight (kg)	Oestrus %
124.123/17	38.9	32%
480.294/18	37.1	43%
1425.633/17	42.5	81%
1811.606/17	37.3	60%
1941.160910/16	37.8	39%
1973.548/18	37.6	53%
2629.993/18	38.2	51%
2744.50705/18	38.9	79%
3422.C362/15	37.8	61%
4548.3444/17	38.8	78%
4591.1844/18	41	81%
4741.MUL777/18	38.3	68%
4851.717/18	39.8	87%
4949.2128/18	39.3	41%
4969.207/18	37.3	90%
4989.160/18	37.6	91%

The genetic component of hogget oestrus 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.

Figure 11 2020-cohort ewe hoggets showing hogget oestrus crayon marks

DATA SUMMARY – 2021 COHORT

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[5], totalling 17 sires (all HD genotyped by GenomNZ) to produce the 2021-cohort. A full list of all cohort sires can be found in Appendix 1.

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 12), 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 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 conceived to AI for the 2021-cohort was approximately 176%.

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

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

Figure 12 Staff involved in the 2021- cohort AI programme.

Table 15. 2021-cohort ewes AI conception rates and pregnancy scanning percentages by sire.
Note pregnancy scanning % is calculated by number of foetuses per number of ewes conceived to AI.

Sire Birth ID	AI conception rate	Pregnancy Scan %
228.136/18	76%	187%
630.223/16	93%	179%
712.5203/04	79%	174%
845.200/19	65%	161%
1425.620/16	89%	186%
1811.1146/19	71%	187%
1973.56/19	83%	171%
2191.200/10	87%	174%
2629.1173/19	71%	164%
2744.51470/19	80%	187%
2749.2309/19	81%	173%
2759.7569/16	85%	177%
3579.191661/19	88%	181%
3855.FR1999/19	67%	151%
4851.623/19	81%	183%
4949.2128/18	89%	173%
4989.563/19	79%	185%
Total/Average	**80.3%**	**176.2%**

Despite roughly the same number of straws from each sire going into ewes of similar weight and BCS, there is still variation between the sires. This may be down to a number of reasons including semen quality and ability of each ewe to conceive.

DATA SUMMARY – 2019 COHORT

Wool Traits

All retained 2019-cohort ewe lambs had seven fleece related traits recorded in December 2020.

On 7th December, 413 ewe hoggets had side samples taken, where a small patch of wool is shorn from the side (near the hipbone) and given a colour score (average 2.2)[6] then sent to SGS (Timaru) for further analysis.

Table 16. Wool quality measures for 2019-cohort ewe hoggets.

Wool Quality Measure	Average (µm)	Min (µm)	Max (µm)
Fibre Diameter (µm)	33.70	26.00	41.60
Standard Deviation of average Fibre Diameter	7.59	5.00	12.10
Coefficient of variation of average Fibre Diameter	22.56	14.80	32.60

Also on December 7th, the same ewes were scored for their bareness characteristics on their belly and breech. Breech bareness averaged 2.0 across the group while belly bareness averaged 1.2[7].

On 15th December, these ewes were shorn and had their fleeces weighed. The average fleece weight was 2.5kg.

Table 17 describes the wool trait indexes by sire.

- 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.
  - **DPWQC** – Dual Purpose Wool Quality Colour Index, in cents per ewe lambing, includes visual wool colour.
- NZGE derived merit - information generated by NZGE, not within flock analysis.
  - **DPWQF** – Dual Purpose Wool Quality Fineness Index, in cents per ewe lambing, includes fibre diameter.

There is significant breed variation in this trial, particularly in the 2019-cohort. It is of note that there were Finn and Wiltshire sires in this cohort, and as Table 17 describes, these have low DPW and high DPBP as they will have shed part of their fleeces.

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

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

[7] 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.

*Table 17. Within flock genetic merit for wool traits for 2019-cohort sires, scaled to the corrected progeny mean. *DPWQF index merit is generated by NZGE analysis (38372, March 2021) not within flock.*

Sire Birth ID	Within Flock			NZGE
	DPW (cents)	DPBP (cents)	DPWQC (cents)	DPWQF* (cents)
151.G197/14				
228.25/16				
1072.737/17				
1425.209/17				
1811.54/17				
1811.606/17				
2368.7165/17				
2629.1020/17				
2744.51137/16				
2744.50985/17				
3666.383/17				
4480.3167/17				
4548.3049/15				
4591.9506/15				
4626.2318/15				
4851.75/17				
4989.282/17				

Methane

170 of the 2019-cohort ewes were selected and measured for methane in March 2021, on farm at Orari Gorge through the portable accumulation chamber (PAC) trailer. Ewes were allocated into 21 groups of 12 animals, with approximately 15 progeny per sire across the measures. In each case, lambs were allocated to each group to ensure that sires were represented across all three measurement days. All animals were weighed prior to being measured. Each ewe was measured for 1 hour.

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

Table 18 describes the PAC methane emission genomic breeding values by sire.

- **PACCH4 gBV** – PAC methane emission gBV estimates methane emitted in g/day. A more positive value indicates higher emissions, a more negative value is desirable. Note this has been reversed in Table 18 below to show less methane emitted than average compared to more methane emitted than average.
  The below gBV information was generated by NZGE, not within flock analysis.

Table 18. 2019-cohort methane PAC breeding values by sire, generated by NZGE analysis 38439, April 2021.

Sire Birth ID	Methane (g/day)
151.G197/14	
228.25/16	
1072.737/17	
4591.9506/15	
1811.54/17	
1811.606/17	
2368.7165/17	
2629.1020/17	
2744.51137/16	
2744.50985/17	
3666.383/17	
4480.3167/17	
4548.3049/15	
4591.9506/15	
4626.2318/15	
4851.75/17	
4989.282/17	

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.

It is important to note that most of the flocks these sires are from have not been selected for methane, therefore what is being demonstrated is the variation between the sires.

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.

A total of 170 ewe hoggets from the 2019-cohort (10 progeny per sire from 17 sires) were randomly chosen and transported from the Orari Gorge Low Input Progeny Test site to the RFI Unit at AgResearch Invermay Agricultural Centre, Mosgiel in July 2020.

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.

Upon arrival at the RFI unit, standard practice for new animals allows 14 days for the animals to transition on to lucerne pellets (the primary feed used in the unit during testing). However, this particular cohort of animals had issues adjusting to the feed during this acclimatisation period. By the end of the 14-day transition period, all except two animals had adjusted. These two animals were removed from the study prior to the 42-day RFI trial period. An investigation revealed that the majority of animals that were slow to adjust were from one sire.

The 168 remaining animals on average gained nearly 18 kg during the 42-day measurement period averaged 343 g/day liveweight gain.

Figure 13. 2019-cohort ewe hoggets at the residual feed intake unit at Invermay.

however, demonstrate a variation of intake and RFI. **Negative RFI values indicate animals which were eating less than predicted and positive values indicate animals which were eating more than predicted.**

Table 19. Examples of individual animals of similar live weight and growth rate, but with very different Residual Feed Intake (RFI) values.
***Most RFI negative values**, **most positive values**.*

Mid-Trial Weight (kg)	**Growth Rate** (g/day)	**Average Intake** (g/day)	**RFI*** (g/day)
49.5	344	2163	-216
49.6	335	2060	-313
49.6	327	2547	182
49.9	334	2058	-323
50.1	371	2279	-156
50.4	350	2551	102
50.5	330	2575	202

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

Sire adjusted means for RFI, displayed in Table 20, are calculated similarly to breeding values. The levels of difference are weighted according to the level of genetic variation observed.

Table 20. 2019-cohort two-tooth ewes, sire adjusted mean for residual feed intake in grams per day.

Sire Birth ID	RFI (g/day)
151.G197/14	
228.25/16	
1072.737/17	
1425.209/17	
1811.54/17	
1811.606/17	
2368.7165/17	
2629.1020/17	
2744.51137/16	
2744.50985/17	
3666.383/17	
4480.3167/17	
4548.3049/15	
4591.9506/15	
4626.2318/15	
4851.75/17	
4989.282/17	

Another aspect of feed intake to consider is feeding behaviour. Individual animals, although showing variation across time often showed a repetitive pattern to their eating behaviour.

It was observed that some animals would consistently have large eating events whilst others would have very small "snack" like feeding events and some animals spend a long time eating and others only a short time. But the two are not intrinsically linked, as some individuals have a slow feeding rate, and so whilst they may be feeding for a long time, they are only consuming modest amounts of feed and are "nibblers", whilst others may have shorter feeding events but are eating fast whilst they are there and so are "guzzlers".

Mating & Pregnancy Scanning

380 of the available 413 2019-cohort two-tooth ewes were mated by AI to create the 2021-cohort. This is the first cohort bred by the progeny test to be mated.

Table 21 describes the average mate weight and BCs in March 2021, alongside the percentage of ewes mated who demonstrated hogget oestrus in May 2020.

The 2019-cohort two-tooth ewes on average weighed 61kg with a BCS of 3.4 at mating.

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.

Of the 380 2019-cohort two-tooth ewes mated, 83% conceived to the AI producing an average scanning percentage of 170% for the age group.

Table 21. 2019-cohort two-tooth ewes' average weight and BCS at mating, AI conception rates and pregnancy scanning percentages by sire.
Note pregnancy scanning % is calculated by number of foetuses per number of ewes conceived to AI.
** **Lower than average**, **higher than average**.*

Sire Birth ID	Average Mate Weight (kg)	Average BCS at Mating (score)	% of ewes demonstrated Hogget Oestrus	AI conception rate %	Pregnancy Scan %
151.G197/14	54.9	3.1	36%	91%	157%
228.25/16	58.7	3.3	86%	74%	188%
1072.737/17	59.1	3.3	56%	75%	173%
1425.209/17	61.5	3.4	74%	89%	146%
1811.54/17	61.9	3.3	19%	80%	175%
1811.606/17	61.7	3.7	70%	78%	143%
2368.7165/17	62.7	3.8	80%	93%	189%
2629.1020/17	60.8	3.3	33%	85%	194%
2744.50985/17	60.9	3.4	75%	87%	185%
2744.51137/16	63.5	3.4	68%	88%	200%
3666.383/17	64	3.7	78%	83%	167%
4480.3167/17	60.8	3.6	36%	86%	150%
4548.3049/15	61.2	3.5	76%	79%	180%
4591.9506/15	58.6	3.2	40%	81%	177%
4626.2318/15	63.7	3.8	69%	96%	148%
4851.75/17	63.3	3.2	62%	79%	168%
4989.282/17	60.6	3.7	82%	71%	173%
Total/Average	**61**	**3.4**	**63%**	**83%**	**170%**

It is important to note that despite the variation in hogget oestrus rates, all sires of the 2019-cohort two-tooth ewes have achieved relatively high conception rates.

There is also a difference to note between conception rate and pregnancy scan percentage. Conception rate is the number of ewes who have conceived to the AI, the pregnancy scan percentage is based on the number of progeny held by these ewes.

Different flocks and breeds will have varied mature ewe size, so again, be mindful of liveweight. As demonstrated in Table 21, the first two sires hold either, one of the highest AI conception rates or pregnancy scan percentages, despite both having lower average mate weights compared to the rest of the group.

In July 2020, 168 of these ewes were sent to the RFI unit at AgResearch Invermay, where they gained an average of 18kg over the 42-day measurement period, averaging a 343 g/day liveweight gain. The remainder of the ewes made little to no weight gain during this same period.

There was concern of extended weight differential at mating. Table 22 displays the weight difference at mating of the two mobs in March 2021.

Table 22. 2019-cohort two-tooth ewes' average weight and BCS at mating comparison of ewes who underwent RFI testing and those who did not.

Group	Number of animals	Average Mate Weight (kg)	Average BCS at Mating (score)
RFI	241	59.8	3.4
Non-RFI	168	62.7	3.5
Total/Average	**409**	**61.0**	**3.4**

IN PROGRESS / UPCOMING MEASUREMENTS

2020-cohort

- RFI – currently underway
- LW12, FW12, FDIAM & COLSC
- Bareness scores

2021-cohort (including 2019-cohort dams)

- Lambing
- Docking
- Weaning

APPENDIX

1. Rams used in 2019, 2020 and 2021 Cohorts

Table 23. 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 24. 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 25. 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	

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