

2020 FLYSTRIKE PREVENTION RD&E PROGRAM PROJECT SUMMARY REPORT

BREEDING AND SELECTION – INDUSTRY TRENDS

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SUMMARY

This update on sheep breeding and selection for flystrike resistance reports on changing genetic trends as indicated by MERINOSELECT ASBVs since 2000. Overall, the genetic trends for lower breech wrinkle are occurring at a modest rate that varies between the three Merino Types, Superfine, Fine and Medium wool Merinos.

However, there are individual breeders specifically breeding Merinos for low wrinkle, low dag and high productivity and these breeders are making considerable gains. The gains are easiest in medium wool Merinos in low dag country and quite difficult in Fine and Superfine Merinos in high dag country. There are now sires that are in the top 1% for low breech wrinkle, top 1% for Adult Clean Fleece Weight and top 1% on Index and also reasonable numbers of sires in the top 5% for these traits although they all tend to be high in fibre diameter. It will take time to breed flock rams with these attributes.

Evidence of the level of productivity of naturally flystrike resistant Merinos will be demonstrated in the Merino Lifetime Productivity (MLP) Project. The lifetime productivity will be determined for the progeny of 134 sires that are collectively high and low for breech wrinkle, dags, breech cover, fleece weight, reproduction, fat and muscle along with the comparison of the accuracy of early in life productivity indicators versus actual lifetime productivity. Woolgrowers will be able to compare the profitability of existing naturally flystrike resistance rams. The MLP project will answer questions and concerns that ram breeders and buyers have about the consequences of selecting for flystrike resistance and other welfare related traits (i.e. survival, worm egg count and fat).

BREECH WRINKLE (BRWR)

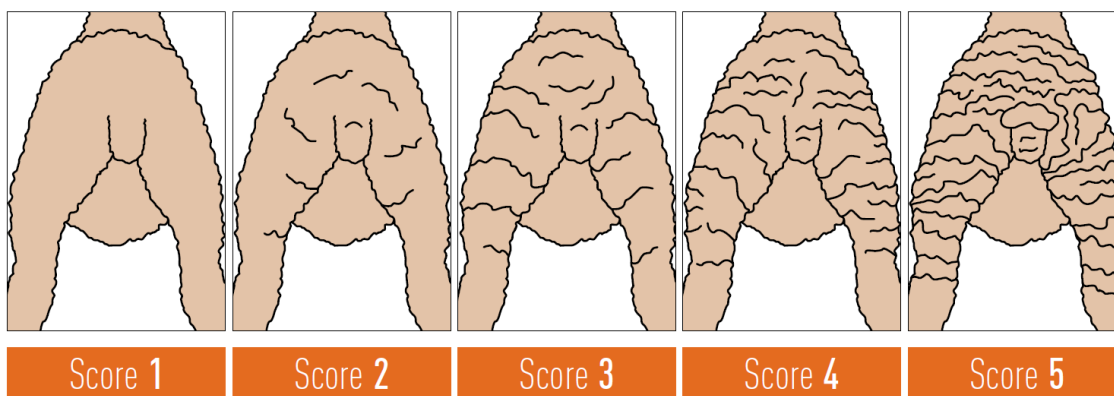


Figure 1. Visual scores for Breech Wrinkle ([AWI/MLA Visual Sheep Score Guide 2019](#))

DAG (DAG)

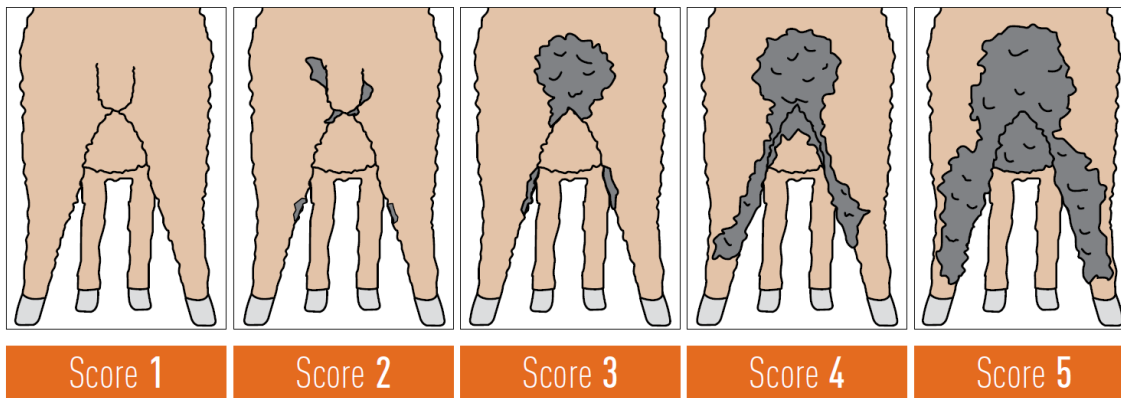


Figure 2. Visual scores for Dag ([AWI/MLA Visual Sheep Score Guide 2019](#))

1. MERINOSELECT ASBV TRENDS SINCE YEAR 2000

Australian Sheep Breeding Values (ASBVs) are an estimate of an animal's breeding value based on its own recorded data and that of the animals in its pedigree. They allow wool growers to make a projection of how an animal's progeny will perform over a range of traits relative to other animals. MERINOSELECT, which is a genetic evaluation service run by Meat & Livestock Australia based in Armidale NSW, analyses pedigree and performance recorded information on animals submitted by members to generate ASBVs and provides the best objective information available on Merino genetic trends. It is limited by the fact that only 30% of Australia's ram breeders are members although the percentage representation increases for large ram breeders and notably, 70% of Merino semen purchased in Australia is from MERINOSELECT members (See Table 9).

MERINOSELECT traits are grouped into fleece and carcass traits, visual traits, worm egg count, reproduction and indexes. The key traits are listed at the bottom of Table 1 and explanation of the traits and indexes can be found on the MERINOSELECT website <http://www.sheepgenetics.org.au/Getting-started/ASBVs-and-Indexes>.

MERINOSELECT commenced operations in 2006 when four separate databases agreed to combine to form a single national genetic evaluation service. The base year for the breech traits (breech wrinkle, breech cover and dag) is 2000, and the base year for all other traits is 1990.

Table 1 (Appendix 1) shows the MERINOSELECT average ASBVs since Year 2000. It includes the trends for the overall Merino breed as well as the three main Merino types, Superfine, Fine and Medium.

Key features of the ASBV genetic trends are:

Merino Breed:

- The total number of animals evaluated by MERINOSELECT each year continues to increase even though the total number of Merino ram flocks and rams sold has decreased since 2000
- The number of animals assessed for wrinkle and dag is increasing
- Body Weight is increasing
- Fat is steady but Muscle is increasing
- Fleece Weight is increasing
- Fibre Diameter is slightly increasing
- Worm Egg Count is decreasing
- Number of Lambs Weaned is steady (from an ASBV of -0.84% in 2000 to -0.55% in 2016)
- Breech Wrinkle is improving slowly (reducing), currently averaging -0.2

- Breech Wool Cover and Dag are steady.

Super Fine Type

- Fleece weight is increasing considerably while the increases for breech wrinkle and fibre diameter have been relatively restrained given the correlations they have with fleece weight. Worm egg count is improving. Current Breech Wrinkle ASBV is +0.1.

Fine Type

- Fleece weight is increasing while breech wrinkle has reduced (improved) by 0.2 score and the fibre diameter trend is steady. Worm egg count is improving. Current Breech Wrinkle ASBV is -0.2.

Medium type

- Fleece weight is increasing and fibre diameter has reduced (improved) while breech wrinkle has been held steady. Worm egg count is improving. Current Breech Wrinkle ASBV is -0.4.

These trends reflect the major economic pressures on woolgrowers over this period and the traits that ram buyers see as important when buying replacement flock rams. Fleece weight is increasing to fill more wool bales. Body weight is increasing as breeders chase higher growth rates. The losses due to worms are three times higher than the annual cost of flystrike (Lane et al, 2015) which is driving the improving worm egg count trends.

There are very mixed messages on the value of improving reproduction from a genetic perspective and it is a complex and costly trait to measure. The flat trends in Number of Lambs Weaned reflect these issues.

The numbers of dag and breech wrinkle records are increasing but genetic gains are modest for breech wrinkle and steady for dag. Breech wrinkle is improving slowly at the breed level and for the Fine wool Merino type. The macro trends in the three breech traits do not reveal what individual ram breeders have been and are doing, to breed naturally flystrike resistant Merinos.

There are a range of reasons for the breech trait genetic trends:

- It takes time for genetic momentum to develop and appear in the breed and type macro trends. ASBVs for breech wrinkle, breech cover and dag were released in late 2009, which is quite recent from a genetic perspective.
- New members joining MERINOSELECT and the increasing number of records are likely to be masking the gains being made by longer-term breech data collecting members (See Table 9).
- The FP+ and MP+ Indexes are promoting higher wrinkle animals (See Section 2).
- There is limited demand for lower wrinkle and lower dag animals as there is a lack of confidence that these types of Merinos can also be profitable. The current economic drivers are leading to gains in fleece weight, body weight and worm resistance.
- The above five issues have hidden the gains made by some individual ram breeders who for the last 5 to 10 years have been actively selecting for improved flystrike resistance and productivity.
- For some horned Merino breeders the demand for polled Merinos has added another trait to the selection criteria and slowed the gains in productivity and other welfare traits.
- There has been a focus on Yearling Fleece Weight rather than Adult Fleece Weight by ram breeders and this has misled breeders particularly with early maturing animals often associated with low wrinkle Merino types. They can, based on percentile ranges, have high early age fleece weight assessments and relatively lower adult fleece weight.
- A large number of Merino ram breeders are in low dag country where dags are only expressed infrequently (i.e. one in every 10 years or so), thus the number of dag records is less than for wrinkle. It is very difficult for these breeders to select for low dag.
- The future RD&E priorities are designed to further address these issues (See Section 4).

In previous RD&E Flystrike Updates (<https://www.wool.com/sheep/welfare/breech-flystrike/latest-research/past-flystrike-prevention-rde-updates/>) there were greater trends to lower wrinkle particularly in the Medium Wool Merino Type than now evident in the 21st April 2020 MERINOSELECT analysis. The change is also believed to be due to increasing animals in MERINOSELECT and more animals being recorded for the breech traits rather than a change in focus by these breeders.

The next section shows that there are leading sires emerging for high productivity and welfare, although more so in the medium Merino types than the others.

2. IMPACT OF INCREASING SELECTION PRESSURE FOR BREECH WRINKLE AND DAG ON CURRENT MERINOSELECT SIRES

Breech Wrinkle

The sire ASBVs required by a Merino breeder to breed progeny that are breech wrinkle score 2 or less, varies due to variations in the environment across Australia. In high wrinkle country target ASBVs are -0.8 to -1.0, in moderate wrinkle country -0.7 and low wrinkle country around -0.3. These are generalisations that need to be modified according to every woolgrower's own environment and their country's risk factors for breech strike. Across a range of environments and sheep types, trials have shown that mulesing reduces breech wrinkle by around 1.0 wrinkle score (range of from 1.5 to 0.5 scores with larger reductions on sheep with higher natural wrinkle) and dag by 0.4 dag score (Lloyd 2010 and Larsen 2012 R&D Technical Update, www.wool.com/flystrikelatest).

Table 3 was created by searching the MERINOSELECT database for all sires with more than 15 current progeny ranked in the Merino Production Plus Index order. There were 2,641 eligible sires in the open unrestricted search and the average ASBVs of the top 10 sires are listed in the table. Their average ASBV for ACFW is 34.5 and for breech wrinkle is +0.3. This shows that the average breech wrinkle ASBV of the 10 highest indexing MP+ sires is 0.5 score higher than the breed average (+0.3 compared to -0.2) which is discussed further below.

When the database search criteria on the upper limit of Breech Wrinkle was changed progressively from +0.2 to an improved -1.0, the average Adult Weight (AWT) ASBV in the top 10 sires moved from 5.4 to 9.2. Cross-checking this AWT range against the MERINOSELECT ASBV percentile bands in Table 2, a 5.6 AWT reflects rams in the top 30%, and a 9.1 AWT reflects rams in the top 5%. Adult Fleece Weight, however, fell but remained in the top 20% (+22), Fibre Diameter fell from the top 25% to the bottom 25% (-1.6 to -0.4), Breech Wrinkle improved from the bottom 15% to the top 1% (+0.3 to -1.1), Dag largely remained at breed average 50% (-0.1) and the MP+ Index fell from the top value but remained in the top 5% (224 to 177).

Search Criteria	Total No of Sires	Average ASBV of top 10 sires in each search						
	Meeting Criteria	AWT Kg	ACFW %	YFD	NLW	EBWR Sc	LDAG Sc	MP+ Index
Open Unrestricted Search	2,641	5.4	34.5	-1.6	14.7	0.3	0.2	224
Breech Wrinkle<= +0.2	1,910	8.6	26.2	-1.2	17.4	-0.2	-0.1	215
Breech Wrinkle<= -0.1	1,362	9.7	24.5	-1.1	17.9	-0.3	0.0	215
Breech Wrinkle<= -0.4	809	10.4	23.4	-0.8	14.8	-0.6	-0.1	208
Breech Wrinkle<= -0.7	349	10.4	25.2	-0.2	10.4	-0.9	0.0	196
Breech Wrinkle<= -1.0	112	9.2	22.1	-0.4	8.5	-1.1	-0.1	177
Leading Low Wrinkle Sire A		11.6	34.3	-0.5	2.0	-1.3	0.0	186
Leading Low Wrinkle Sire B		10.2	28.4	-0.5	7.0	-1.1	-0.3	174
Leading Low Wrinkle Sire C		12.3	24.1	-1.0	20.0	-0.7	-	229
Leading Low Wrinkle Sire D		9.4	26.5	-0.4	11.0	-0.7	-0.2	202
Leading Low Wrinkle Sire E		14.3	26.2	0.3	19.0	-0.7	-0.2	214

Abbreviations; AWT - Adult Body Weight, ACFW - Adult Clean Fleece Weight, YFD - Yearling Fibre Diameter, NLW - Number of Lambs Weaned, EBWR Sc- Early Breech Wrinkle Score, LDAG Sc - Late Dag Score, MP+ - Merino Production Plus Index

Putting an upper limit of even +0.2 had a large effect in reducing the average wrinkle score of the 10 leading sires, from +0.3 to -0.2 with very little impact on the index. An upper limit of -0.1 reduced the wrinkle score from +0.3 to -0.3 again with very little impact on the index. Significant gains can be made by not considering just high wrinkle sires.

This database search demonstrates that breeding productive low breech wrinkle naturally breech strike resistant Merinos can be achieved in low dag country using existing sires based on the MP+ Index but with a large increase in Fibre Diameter and an increase in Adult Body Weight.

The ASBVs of some of the leading low breech wrinkle sires are shown in the bottom half of Table 3. Sire A is in the top 1% for fleece weight and top 1% for breech wrinkle. It is a young sire from a ram breeder in low dag country who is putting large selection pressure on high fleece weight and low breech wrinkle.

All the leading sires listed in Table 3 come from breeders with strong selection pressure on low breech wrinkle and high productivity with a focus on fleece weight. There are no leading sires by chance; they have been actively selected and bred by their owners. It should be noted that the fibre diameter for these sires is below average (ie broader) whilst the ASBVs for dag are average, suggesting that progress in breeding for breech strike resistance is likely to be easier for medium type Merinos in low dag environments.

Table 4 was created by searching all sires with more than 15 current progeny, ranked this time in the Dual Purpose Plus Index order. There were again 2,641 eligible sires in the open unrestricted search and the average ASBVs of the top 10 sires are listed. For the top 10 sires the average ASBV for Adult Clean Fleece Weight is lower at 29.6, Fibre Diameter higher at -1.2, yet the Breech Wrinkle ASBV is lower at -0.2 (breed average) compared to Table 3.

The upper limit search criteria for Breech Wrinkle was progressively changed from +0.2 to -1.0. The impact this had on the top 10 sires' average results based on the DP+ Index are listed in Table 4. In percentile terms Adult Weight remained in the top 1 to 5%, Fleece Weight fell from the top 1% to top 30%, Fibre Diameter fell from the top 40% to bottom 20%, Breech Wrinkle improved from average 50% to top 1-5%, Dag improved from the bottom 20% to top 30% and the DP+ Index remained constant from the near top value to the top 1%.

Table 4, All Merino Types, Average ASBVs of top 10 sires with more than 15 progeny based on DP+ Index for each search criteria								
Search Criteria	Total No of Sires Meeting Criteria	Average ASBV of top 10 sires in each search						
		AWT Kg	ACFW %	YFD	NLW	EBWR Sc	LDAG Sc	DP+ Index
Open Unrestricted Search	2,641	9.1	29.6	-1.2	16.9	-0.2	0.1	234
Breech Wrinkle<= +0.2	1,910	9.9	22.8	-0.9	18.3	-0.4	0.0	232
Breech Wrinkle<= -0.1	1,362	9.9	22.7	-0.9	18.3	-0.4	0.0	231
Breech Wrinkle<= -0.4	809	10.4	23.1	-0.8	15.5	-0.6	-0.1	226
Breech Wrinkle<= -0.7	349	10.2	21.1	-0.4	13.0	-0.9	-0.1	212
Breech Wrinkle<= -1.0	112	9.7	18.8	-0.3	10.2	-1.1	-0.2	196
Leading Low Wrinkle Sire A		11.6	34.3	-0.5	2.0	-1.3	0.0	193
Leading Low Wrinkle Sire F		11.9	27.3	0.5	5.0	-1.1	-0.1	210
Leading Low Wrinkle Sire G		9.4	26.5	-0.4	11.0	-0.7	-0.2	218
Abbreviations DP+ Index - Dual Purpose Plus Index								

Table 3 and 4 show that reducing breech wrinkle and increasing fleece weight is difficult if you are breeding fine wool sheep as there was a large corresponding increase in fibre diameter. There are very few ultrafine and superfine animals in MERINOSELECT with breech wrinkle scores less than zero so a similar process for Table 3 and 4 was not possible for Superfine Merino types.

So, for the Superfine Merino type, a different approach was undertaken. The upper fibre diameter limit was reduced progressively from -2.0 to -4.0. See Table 5. The Breech Wrinkle Score of the 10 highest FP+ indexing sires remained in the bottom 10% and very few sires were less than +0.3. High Indexing, low breech wrinkle

superfine sires are difficult to find and breed, but ram breeders are taking up the challenge. There is evidence in the pedigree of the leading Superfine sires that ‘outcross’ sires are being used to reduce breech wrinkle, increase fleece weight, while attempting to minimise the increase in fibre diameter in Superfine Merinos.

Table 5. Ultra Fine/ Super Fine Type, Average ASBVs of top 10 sires with more than 15 progeny based on FP+ Index for each search criteria

Search Criteria	Total No of Sires Meeting Criteria	Average ASBV of top 10 sires in each search						
		AWT Kg	ACFW %	YFD	NLW	EBWR Sc	LDAG Sc	FP+ Index
Yearling FD <= -2.0	139	0.4	17.8	-3.0	-0.9	0.6	-0.1	179
Yearling FD <= -2.5	87	0.5	16.5	-3.1	-1.3	0.6	0.0	178
Yearling FD <= -3.0	37	1.2	11.0	-3.5	0.6	0.5	-0.1	172
Yearling FD <= -3.5	24	0.0	2.2	-4.0	-3.8	0.3	-0.1	158
Yearling FD <= -4.0	14	-0.7	-8.9	-5.2	-22.9	N/A	N/A	131
Leading Low Wrinkle Sire H		-1.5	-0.8	-3.6	n/a	-0.2	0.0	144
Leading Low Wrinkle Sire I		3.2	6.6	-4.3	1.0	-0.1	-0.2	160
Leading Low Wrinkle Sire J		0.7	10.6	-3.5	n/a	0.2	0.1	175
Abbreviations FP + Index - Fine Production Plus Index								

Dag

Putting selection criteria on current sires to reduce breech wrinkle had limited impact on reducing dags as seen in Tables 3, 4 and 5. This is expected as most of the leading sires are in low dag country, where dags are infrequently expressed. In high dag country dags can be the highest breech strike risk factor, particularly during winter and spring.

Table 6 was created using a similar search to Table 3, by searching all sires with more than 15 current progeny, ranked Merino Production Plus Index order but placing upper limits on dag. There were again 2,641 eligible sires in the open unrestricted search and the average ASBVS of the top 10 sires are listed. The dag score for these top 10 sires was +0.2 which is 0.3 dag score higher than the breed average (+0.2 compared to the breed average of -0.1).

The upper limit search criteria for Dag was progressively changed from -0.1 to -0.6. The impact this had on the top 10 sires average results based on the MP+ Index are listed in Table 6. In percentile terms Adult Weight remained in the top 10 to 20%, Fleece Weight fell from the top 1% to top 20%, Fibre Diameter fell from the top 40% to bottom 30%, Breech Wrinkle improved from the bottom 20% to top 40%, Dag improved from the bottom 10% to more than the top 1% and the MP+ Index fell from the near top value to top 10%.

This demonstrates that breeding productive low dag Merinos can be achieved using existing sires based on the MP+ Index, however growers need to be prepared for a fall in fleece weight and a large increase in fibre diameter. Again, it shows the difficulty of breeding low dag fine and super fine wool Merinos.

Table 6. All Merino Types, Average ASBVs of top 10 sires with more than 15 progeny based on MP+ Index for each search criteria

Search Criteria	Total No of Sires Meeting Criteria	Average ASBV of top 10 sires in each search						
		AWT Kg	ACFW %	YFD	NLW	EBWR Sc	LDAG Sc	MP+ Index
Open Unrestricted Search	2,641	5.4	34.5	-1.6	14.7	0.3	0.2	224
Dags <-0.1	896	6.2	28.3	-1.7	16.3	0.0	-0.2	216
Dags <-0.2	472	7.2	26.3	-1.5	15.1	-0.1	-0.3	214
Dags <-0.3	229	6.9	31.8	-1.0	11.3	-0.2	-0.4	200
Dags <-0.4	100	5.8	25.6	-0.9	6.3	-0.1	-0.5	188
Dags <-0.5	42	7.0	15.7	-0.4	10.1	-0.4	-0.6	174
Dags <-0.6	24	7.7	15.4	-0.5	10.6	-0.4	-0.7	169
Leading Low Dag Sires		9.5	46.2	0.7	7.0	-0.2	-0.6	195
Leading Low Dag Sires		5.1	18.8	-2.3	0.0	-0.3	-0.5	187
Leading Low Dag Sires		6.0	25.5	0.1	5.0	-0.6	-0.5	180
Leading Low Dag Sires		8.4	7.6	-0.7	15.0	0.0	-0.9	172

Abbreviations; AWT - Adult Body Weight, ACFW - Adult Clean Fleece Weight, YFD - Yearling Fibre Diameter, NLW - Number of Lambs Weaned, EBWR Sc- Early Breech Wrinkle Score, LDAG Sc - Late Dag Score, MP+ - Merino Production Plus Index

Breech Wrinkle, Dag and Fibre Diameter

Woolgrowers in high dag country need significant reductions in both breech wrinkle and dag to breed and create naturally resistant Merinos. Table 7 was created by searching all sires with more than 15 current progeny, ranked Merino Production Plus Index order with progressively lower upper limits on both breech wrinkle and dag. Fleece weight fell, fibre diameter rose while breech wrinkle and dag fell to naturally resistant levels for moderate wrinkle and dag country. Again, the rise in fibre diameter makes it difficult for woolgrowers who need fine wool with low diameter variation to breed for reduced breech strike.

A few sires could be found that were low in fibre diameter (less than -2.0) with moderate breech wrinkle and dag. However, of the total 2,641 eligible sires available on MERINOSELECT only one sire in the database is a trait leader (top 10%) for Wrinkle, Dag, Adult Fleece Weight and the MP+ Index yet its Fibre Diameter is high at +0.5.

Table 7. All Merino Types, Average ASBVs of top 10 sires with more than 15 progeny based on MP+ Index for each search criteria

Search Criteria	Total No of Sires Meeting Criteria	Average ASBV of top 10 sires in each search						
		AWT Kg	ACFW %	YFD	NLW	EBWR Sc	LDAG Sc	MP+ Index
Breech Wrinkle <-0.2 and Dags<-0.1	606	9.5	22.7	-0.9	16.3	-0.4	-0.3	209
Breech Wrinkle <-0.4 and Dags<-0.2	268	10.7	18.6	-0.9	14.4	-0.7	-0.3	202
Breech Wrinkle <-0.5 and Dags<-0.3	103	9.7	20.6	-0.9	8.7	-0.7	-0.4	188
Breech Wrinkle <-0.6 and Dags<-0.4	39	8.6	12.6	-0.5	7.7	-0.8	-0.5	165
Breech Wrinkle <-0.2, Dags<-0.1 and YFD<-2	30	4.3	18.1	-2.3	2.0	-0.3	-0.2	175
Breech Wrinkle <-0.4, Dags<-0.2 and YFD<-2	9	6.6	5.9	-2.4	1.6	-0.6	-0.4	155
Trait Leader Wrinkle, Dag, Fleece Wt & MP+	1	11.6	37.5	0.5	8.0	-1.0	-0.3	181

Breeding naturally breech strike resistant high indexing fine wool Merinos will take some considerable time. Fine wool breeders that already manage their flystrike risk without mulesing have long used other management strategies to help reduce the risk of breech strike. Approaches include regular long acting chemical treatments, additional crutching and shearing and closer supervision of their animals. Much of the fine wool environment is low phenotypic wrinkle country; cold, wet, windy and wormy where Breech Wrinkle ASBV's of -0.3 to -0.5 are likely to be required. Importantly from the Breeding for Breech Strike Resistance project, every 0.1 score reduction in any trait, wrinkle, cover, stain and or dags reduces the risk of breech strike, irrespective of the starting natural score.

3. POTENTIAL OUTCOMES OF THE MERINO LIFETIME PRODUCTIVITY PROJECT FOR BREEDING NATURALLY FLYSTRIKE RESISTANT MERINOS

The MLP project is a \$12M, 10-year partnership between AWI, the Australian Merino Sire Evaluation Association (AMSEA), 5 Breeder Site Committees, 5 Site Hosts and nominating Stud Merino breeders. AWI is providing \$7M and the remaining \$5M comes from Site Hosts, Site Committees and Entrants.

The Site Hosts and Committees are:

- Balmoral** – “Tuloona”, Harrow, Vic (Tuloona Pastoral and Balmoral Breeders Site Committee)
- Pingelly** - UWA Farm Ridgefield, Pingelly WA (Murdoch University and Federation of Performance Sheep Breeders (WA Branch))
- MerinoLink** - “The Vale”, Temora, NSW (MerinoLink Limited, Moses and Son, Bluechip Livestock)
- Macquarie** - Trangie Agricultural Research Centre, Trangie, NSW (NSW DPI and Macquarie Sire Evaluation Association)
- New England** - “Chiswick”, Uralla, NSW (CSIRO and New England Merino Sire Evaluation Association)

The MLP project (2015-2025) is running at the above sites where sire evaluation trials are conducted for the first two years and then continues to track the performance of the 5,700 F1 ewe progeny from 134 sires as they proceed through four to five joinings, lambings and annual shearings. A full suite of assessments are being taken including visual trait scoring, objective assessment of a broad range of traits, classer gradings and index evaluations. 134 sires were artificially inseminated to 90 ewes each. They were carefully selected from hundreds of industry nominations to allow a comprehensive examination of all the factors that might influence lifetime productivity, and to generate results that will be both industry representative and relevant.

Sire selection was targeted to minimise bias. The target was to achieve a balance across each site and drop, along with an overall strategy that the project’s sire list across all sites would meet the following criteria:

- **Industry representative:** a balance between horn poll rams, different skin/wool types, rams with and without Australian Sheep Breeding Values (ASBVs).
- **Impact rams:** Significant show performance results or widely used AI sires in industry (with or the without ASBVs).
- **Genetically representative:** Selected from four main genetic performance groups within the MERINOSELECT database. These groups were identified using a unique analysis of the MERINOSELECT database that included progeny of sires used between 2006 and 2016. The number of animals from each group aimed to match the proportion of each group in MERINOSELECT.
- **Performance range:** High and low performance for key traits based on ASBV percentile band tables.
- **Fleece value:** Sires predicted to maintain, increase or decrease fleece value over time.
- **Sire Age:** A balance of young (progeny yet to be evaluated) and older rams.

The final sire lists at each site were generated in consultation with each Sire Evaluation Site Committee plus the MLP Industry Steering Committee. (There is greater detail at <https://merinosuperiorsires.com.au/wp-content/uploads/2020/05/MLP-Sire-Selection-Process-and-Stocktake-FINAL.pdf>).

This unique and extensive dataset will be used to enhance existing Merino breeding and selection strategies, for both ram sellers and buyers, to deliver greater lifetime productivity and woolgrower returns.

All sires except for three, currently have progeny assessed as pre lambing 2-year old’s and over the next 4 years all the adult production records for all traits will be recorded for all sires. By August 2020, all sires will have progeny results collected at 2 years old. The formal project assessment will be between the sires using within project Flock Breeding Values (FBVs) with all the repeat adult data which will not occur until 2025.

All the MLP data is available for use in MERINOSELECT and the repeat MLP adult data will be an important asset for ongoing RD&E in Merino Genetic Benchmarking. Data from the MLP Add-On projects, particularly regarding Resilience (CSIRO) and Economic Evaluation of Genetic Gain (Murdoch University) will add to the data flow and cooperation between the MLP projects and MERINOSELECT (See Section 4).

Below is the current (April 2020) ASBV data on the 134 MLP sires which combines both the MLP data with across MERINOSELECT members on farm data. Tables 8 to 12 show that the balance in sire performance has been achieved and is truly Industry representative. Table 8 shows that there is a wide variation in the ASBVs of the 134 MLP sires particularly in the welfare traits of fat, worm egg count, breech wrinkle and dag.

Table 8. Range in performance of MLP sires based on current ASBVs (April 2020)

	ycfw	acfw	yfd	yss	Ysl	ywt	awt	yfat	yemd	ywec	ebwr	edag	nlw	DP+	MP+	FP+
Min	-23	-30	-4.3	-6.4	-17.3	-3.8	-4.4	-2.9	-3.0	-78	-1.6	-0.5	-24%	88	96	93
Max	43	43	2.2	11.1	26.4	12.9	12.1	2.9	3.9	141	1.4	0.7	23%	230	226	195
Ave	21	19	-1.3	0.7	5.5	5.8	4.5	-0.2	0.1	9	0.0	0.0	-1%	157	159	148
MS [#]	15	13	-1.0	0.6	7.1	4.8	3.9	0.1	0.3	-16	-0.2	0.0	1%	144	143	136

[#] the average of the 2018 drop Merino progeny in MERINOSELECT

Table 9 compares the current differences between the sires based on MERINOSELECT membership status. It shows there are differences between the two in some traits, but also reasonable similarity in others. The indexes are well aligned now, with the ongoing caveat that there are still four years to run in the MLP project and the best comparison will be at the end of the project using MLP only data. Not surprisingly, visual selection for key traits that are “visually expressed”, highly heritable and are not antagonistic (don’t work against each other) combined with the aid of raw data has been very successful as Table 9 indicates for fleece weight, body weight and fibre diameter. Where the number of traits under selection increase, where there are a number of antagonist traits under selection and/or there are a number of “non visual traits”, using ASBV’s appears to be advantageous i.e. for fat, muscle, worm egg count, wrinkle and reproduction traits. (Note Table 9 only shows a comparison of MERINOSELECT membership status, members within each status can also have very differing selection strategies)

Table 9. Number of sires entered based on MERINOSELECT membership status (April 2020)

Status	No	ycfw	acfw	yfd	yss	ysl	ywt	Yfat	yemd	ywec	ebwr	edag	nlw	DP+	MP+	FP+
Non	35	22	23	-1.1	1.2	0.6	5.2	-0.7	-0.5	32	0.2	0.05	-3%	152	158	146
Member*	99	21	17	-1.3	0.6	7.3	6.0	0.0	0.3	2	0.0	-0.01	0%	159	160	149
Total	134	21	19	-1.3	0.7	5.5	5.8	-0.2	0.1	9	0.0	0.00	-1%	157	159	148

*Includes one Dohne

Table 10 shows the broad range of Breech Wrinkle of the MLP sires. Seventeen sires average -1.1 for Breech Wrinkle and eighteen sires average +1.0. The occurrence of the different breech wrinkle scores along with other traits can be seen and replicates outcomes above in Section 2 when upper limits were placed on Breech Wrinkle on the current 2,631 sires in MERINOSELECT. There are large differences in fibre diameter, fat, muscle and NLW between the breech wrinkle categories.

Table 10. Average ASBV Performance of Sires Based on Breech Wrinkle (EBWR) ASBV (April 2020)

EBWR ASBV	Count	ycfw	acfw	yfd	yss	ysl	ywt	awt	yfat	yemd	ywec	ebwr	edag	nlw
< -0.7	17	19	12	-0.1	0.5	18.0	7.9	6.6	1.0	1.6	-7	-1.1	-0.07	5%
-0.6 to -0.1	43	20	17	-1.2	1.1	7.4	7.2	6.0	0.2	0.6	-1	-0.3	-0.06	2%
0 to +0.3	28	27	24	-1.2	1.0	6.1	6.3	5.0	-0.5	-0.2	25	0.1	0.01	0%
+0.4 to +0.7	28	22	21	-1.8	1.0	-0.1	4.3	3.0	-0.6	-0.7	14	0.5	0.01	-2%
>0.8	18	16	18	-2.2	-0.7	-2.9	2.0	0.5	-1.0	-0.8	19	1.0	0.22	-10%
Total	134	21	19	-1.3	0.7	5.5	5.8	4.5	-0.2	0.1	9	0.0	0.00	-1%

Table 11 shows a good range in Dag for the MLP sires. Twelve sires average -0.4 for and fifteen sires average +0.4 and the occurrence of the different dag scores with the other traits.

Table 11. Average ASBV Performance of Sires Based on Dag ASBV (April 2020)

EDAG ASBV	Count	ycfw	acfw	yfd	yss	ysl	ywt	awt	yfat	yemd	ywec	Ebwr	edag	nlw
< -0.4	12	20	14	-0.9	1.2	7.8	7.8	6.3	0.7	0.8	-22	-0.2	-0.4	5%
-0.2 to -0.1	46	20	17	-1.5	0.6	6.3	5.8	4.6	0.0	0.4	9	-0.2	-0.1	2%
0	23	23	21	-1.0	0.2	6.6	5.5	4.3	-0.3	-0.1	6	0.0	0.0	-3%
+0.1 to +0.2	38	23	20	-1.2	1.1	5.3	5.9	4.5	-0.4	-0.3	21	0.2	0.1	-1%
>0.3	15	20	21	-1.8	0.7	0.2	4.4	3.1	-0.6	-0.4	13	0.6	0.4	-6%
Total	134	21	19	-1.3	0.7	5.5	5.8	4.5	-0.2	0.1	9	0.0	0.0	-1%

Table 12 shows the broad range of Fibre Diameter associated with the sires in the MLP project. The occurrence of low Fibre Diameter with high Breech Wrinkle is again illustrated. Twelve sires average -3.2 for fibre diameter and eight sires average +0.8. The impact of the different diameter groups impacts fleece weight at the low end only, but across the board for weight, fat, muscle and wrinkle.

Table 12. Average ASBV Performance of Sires Based on Fibre Diameter (FD) ASBV (April 2020)

FD ASBV	Count	ycfw	acfw	yfd	yss	ysl	ywt	awt	yfat	yemd	ywec	ebwr	edag	nlw
SF <-2.8	12	8	5	-3.2	-1.4	-4.0	2.6	1.2	-0.4	-0.2	-11	0.8	0.08	-8%
F -2.7 to -1.8	33	20	19	-2.2	-0.5	2.3	4.7	3.2	-0.3	-0.1	15	0.2	-0.03	0%
FM -1.7 to -0.8	47	23	21	-1.2	0.6	5.2	5.9	4.6	-0.5	-0.3	22	0.0	0.05	-1%
M -0.7 to +0.3	34	24	20	-0.3	2.2	10.1	7.4	6.2	0.2	0.6	-2	-0.2	-0.04	1%
S > +0.4	8	26	20	0.8	3.2	15.5	7.9	6.9	0.7	1.4	3	-0.7	-0.04	1%
Total	134	21	19	-1.3	0.7	5.5	5.8	4.5	-0.2	0.1	9	0.0	0.00	-1%

The variability in traits of the MLP sires is large and when grouped on breech wrinkle, dag and fibre diameter they mirror the impact of changing the upper limits in the animals search functions on the 2,641 current sires in Section 2.

Of specific interest regarding breeding naturally flystrike resistant Merinos, will be the lifetime performance of high and low sires for breech wrinkle, dag, breech cover, fleece weight, reproduction, fat and muscle along with the comparison of the accuracy of early in life productivity indicators of productivity versus actual lifetime performance. Woolgrowers will be able to witness the relative profitability of naturally flystrike resistance sheep and the project will answer questions and concerns that ram breeders and buyers have about the consequences of selecting for flystrike and welfare traits (i.e. survival, polls, worm egg count and the breech traits).

4. FUTURE RD&E PRIORITIES TO ASSIST WOOLGROWERS BREED NATURALLY FLYSTRIKE RESISTANT MERINOS

The Breeding for Breech Strike Resistance Flocks ran from 2005 to 2015. Since 2008 they have been a major contributor to the biennial Breech Strike Technical RD&E updates and to the commercial release of ASBVs for Breech Wrinkle, Dag and Breech Cover in late 2009. This was followed by two phases of a project investigating associations between 1,526 animals high density DNA genotypes and their flystrike records and another project investigating the role that odour and skin bacteria might play in attracting gravid flies to lay their eggs on some and not other sheep. The genotype study could not find any single genes of major effect, but that a genome wide analysis was likely to have benefits although further R&D is required.

The odour study could not find the specific odours that attracted the gravid fly although it was shown the sniffer dogs could determine a difference between wool samples taken from resistant and susceptible sheep some 18

months after the flystrike trial period. These outcomes have been reported at the Technical Updates from 2008 to 2018.

AWI does have two current projects looking at improving resilience in the Merino and improving productivity and profitability measures in Merinos. Both are well aligned with breeding naturally flystrike resistant, highly productive Merinos. The Improving Resilience in Merino's project is with the CSIRO Armidale and the Genetic Evaluation of Productivity Efficiency and Profit project with Murdoch University.

The Breeding and Selection pillar of the Flystrike Strategy has entered a phase with an increased focus on development and extension. Priorities for this work include:

- Further development to allow the use of neck wrinkle to create Breech Wrinkle ASBVs for very low breech wrinkle Merinos and Dohnes. (Body wrinkle already contributes to breech wrinkle).
- Investigations into other flystrike resistance related indicator traits
The breech flystrike causal web captures a number of risk factors for flystrike that could be captured by ASBVs to enable growers to select for them, potentially reducing their overall flystrike risk. Work to understand the genetic heritability, and therefore appropriateness of developing ASBVs for risk factors such as fleece rot, urine stain and faecal consistency will be investigated.

Development of a Survival / Longevity ASBV Survival and longevity are complicated traits but are important welfare and economic considerations. Data from the MLP project will be needed to create these new traits.

- Creation of Flystrike Resistance and Improved Welfare influenced Indexes
The MP+ and FP+ Indexes are not influenced by breech wrinkle or dag and as a result these indexes are tending to inadvertently promote higher wrinkle animals due to their association with increased fleece weight. GRASS Merino's have developed an index that puts pressure on reducing breech wrinkle and this will be released for public use in 2020. Development of further welfare influenced Indexes is planned.
- Improved estimation of adult age traits from young age assessments
Current genetic advice is for ram breeders to collect 1) pedigree, 2) yearling fleece and carcass assessments 3) late hogget fleece and carcass assessments and 4) repeat adult reproduction records, although this recommendation may change with outcomes of the MLP project. This is time consuming and expensive and most ram breeders do not collect hogget or adult records, However, in the meantime, better predictions of lifetime performance using yearling data could assist with optimising profitability and welfare gains for early and late maturing animals.
- Cost benefit assessment of a virtual genomic flock for flystrike / welfare traits
Woolgrowers actively protect animals from flystrike so direct assessment of this trait is difficult and complex. AWI is investigating the option of a virtual genomic flock such that when a breeder does get a struck animal its genotype and that from a non-struck animal in the same mob could be used to develop a predictive Flystrike ASBV. The same approach may also assist with Survival and Longevity.
- Improving sampling protocols for Worm Egg Count ASBV
As ram breeders have made genetic gains it has become harder to meet the minimum level of worms required to obtain a good assessment. The level required can also impact on the growth rate and condition of the animals. A new method, the mini-FLOTAC, of assessing worm egg counts, which presents a superior sensitivity compared to the current method, is being trialed.

FURTHER INFORMATION

Further information on AWI's Sheep Genetics projects is available on the AWI website at www.wool.com/sheep/genetics.

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APPENDIX 1.

Table 1 MERINOSELECT ASBVs Trends by Overall Breed and Merino Type since 2000

Merino Breed																				
Year of Birth	Animals Recorded	ywt ASBV	awt ASBV	yfat ASBV	yemd ASBV	ygfw ASBV	agfw ASBV	acfw ASBV	yfd ASBV	yss ASBV	ywec ASBV	nlw ASBV	ebwr ASBV	ebwr Records	ebcov ASBV	ldag ASBV	ldag Records	FPP ASBV	MPP ASBV	DPP ASBV
drop head	kg	kg	mm	mm	%	%	%	micron	N/Kt	%	score	score	score	head	score	score	head	index	index	index
2000	44,254	0.0	-0.5	0.0	0.1	0.9	0.0	2.7	-1.2	-0.5	4.6	-0.84	0.0		-0.1	0.0	436	118	117	115
2002	78,177	0.5	0.1	0.0	0.2	0.3	-0.2	2.4	-1.3	-0.4	0.6	-1.60	-0.1		0.0	0.0	768	121	118	117
2004	73,653	0.9	0.5	0.1	0.3	0.6	-0.2	2.7	-1.3	-0.2	-1.7	-1.75	-0.1		0.0	0.0	640	121	119	119
2006	62,734	1.6	1.2	0.1	0.3	2.5	0.9	4.0	-1.2	0.2	-6.7	-2.23	-0.1	2,654	0.0	0.0	2,728	123	123	122
2008	67,757	1.9	1.4	0.1	0.3	4.1	1.9	5.0	-1.2	0.3	-6.0	-1.56	-0.1	13,691	0.0	0.0	7,139	126	126	125
2010	69,743	2.6	2.0	0.1	0.4	5.2	2.8	6.3	-1.1	0.3	-8.1	-1.73	-0.1	19,291	-0.1	0.0	5,277	127	128	128
2012	99,453	3.0	2.4	0.1	0.4	5.7	3.3	7.1	-1.1	0.4	-9.8	-1.24	-0.1	26,636	-0.1	0.0	8,680	128	130	130
2014	116,934	3.3	2.6	0.1	0.3	7.6	4.7	8.8	-1.1	0.5	-11.7	-0.63	-0.1	20,501	-0.1	0.0	11,773	130	134	133
2016	118,174	4.0	3.2	0.1	0.4	9.5	6.1	10.6	-1.0	0.6	-14.3	-0.55	-0.2	23,229	-0.1	0.0	10,682	132	137	138
2018	127,787	4.7	3.9	0.1	0.4	11.8	7.8	12.7	-1.0	0.5	-17.2	0.76	-0.2	27,787	-0.1	-0.1	7,982	136	143	145
Super Fine Wool Merino Type																				
Year of Birth	Animals Recorded	ywt ASBV	awt ASBV	yfat ASBV	yemd ASBV	ygfw ASBV	agfw ASBV	acfw ASBV	yfd ASBV	yss ASBV	ywec ASBV	nlw ASBV	ebwr ASBV	ebwr Records	ebcov ASBV	ldag ASBV	ldag Records	FPP ASBV	MPP ASBV	DPP ASBV
2000	13,541	-2.0	-2.4	0.2	0.4	-10.0	-10.4	-8.9	-1.9	-0.4	3.7	-0.90	0.0		0.0	0.1	292	113	102	99
2002	18,457	-1.9	-2.2	0.1	0.3	-10.3	-10.5	-9.4	-2.0	-0.5	-1.2	-2.42	0.0		0.0	0.0		115	103	99
2004	21,364	-1.9	-2.1	0.2	0.4	-10.2	-10.2	-8.8	-2.0	-0.5	-2.1	-3.07	0.0		0.0	0.0	195	116	104	100
2008	17,642	-0.6	-1.1	0.1	0.3	-4.9	-6.4	-4.6	-2.0	0.0	-3.2	-4.59	0.1	2,236	0.1	0.0	1,347	123	115	109
2010	14,200	-0.3	-0.9	-0.1	0.2	-3.3	-4.8	-2.6	-2.0	-0.2	-15.5	-4.98	0.1	1,452	0.1	0.0	1,005	126	117	111
2012	20,319	0.0	-0.5	-0.1	0.1	-3.6	-5.0	-2.5	-2.0	0.0	-7.2	-5.17	0.1	2,893	0.1	0.0	1,742	127	118	113
2014	17,571	0.6	-0.1	-0.1	0.2	0.1	-1.9	0.6	-1.9	0.3	-13.9	-3.08	0.1	2,366	0.0	0.0	1,419	130	124	119
2016	16,085	1.7	1.0	-0.1	0.2	2.7	0.0	2.9	-1.8	0.2	-17.2	-3.71	0.1	2,431	0.1	0.0	2,269	132	129	125
2018	13,199	2.9	1.9	0.0	0.4	6.6	3.0	6.7	-1.7	0.3	-16.6	-4.84	0.1	1,561	0.0	0.0	1,384	137	137	135
Fine Wool Merino Type																				
Year of Birth	Animals Recorded	ywt ASBV	awt ASBV	yfat ASBV	yemd ASBV	ygfw ASBV	agfw ASBV	acfw ASBV	yfd ASBV	yss ASBV	ywec ASBV	nlw ASBV	ebwr ASBV	ebwr Records	ebcov ASBV	ldag ASBV	ldag Records	FPP ASBV	MPP ASBV	DPP ASBV
2000	30,306	0.5	0.0	-0.2	-0.1	5.2	4.3	7.4	-1.1	-0.9	6.6	-0.11	0.0		0.0	0.0	144	122	124	123
2002	53,280	0.8	0.5	0.0	0.2	3.2	3.0	5.9	-1.2	-0.5	0.2	-1.93	0.0		0.0	0.0	768	124	124	123
2004	47,671	1.3	0.9	-0.1	0.1	4.2	3.9	7.0	-1.2	-0.2	-3.3	-2.51	0.0		-0.1	0.0	445	125	126	125
2006	37,384	1.9	1.5	0.0	0.2	6.1	4.5	8.1	-1.0	0.2	-10.3	-2.38	-0.1	1,117	-0.1	-0.1	1,979	126	128	127
2008	40,024	2.3	1.7	0.0	0.2	7.4	5.0	8.6	-1.1	0.3	-8.2	-0.82	-0.1	9,361	-0.1	0.0	4,539	129	132	131
2010	40,450	2.8	2.2	0.1	0.4	7.2	5.0	8.8	-1.1	0.5	-4.3	-0.74	-0.1	15,163	-0.1	0.0	3,777	130	133	133
2012	58,737	3.1	2.5	0.0	0.3	7.5	5.3	9.3	-1.1	0.4	-9.2	-0.75	-0.1	20,806	-0.1	0.0	6,250	131	134	134
2014	64,250	3.3	2.7	0.0	0.3	9.0	6.1	10.5	-1.1	0.6	-10.3	-0.41	-0.1	16,845	-0.1	0.0	7,772	133	137	136
2016	61,807	4.3	3.5	0.1	0.4	11.0	7.2	11.9	-1.0	0.8	-15.3	0.38	-0.2	16,676	-0.2	-0.1	6,520	136	142	142
2018	66,612	4.7	3.9	0.1	0.4	13.1	8.7	13.7	-1.1	0.7	-17.3	2.87	-0.2	14,752	-0.1	-0.1	3,906	140	147	148
Medium Wool Merino Type																				
Year of Birth	Animals Recorded	ywt ASBV	awt ASBV	yfat ASBV	yemd ASBV	ygfw ASBV	agfw ASBV	acfw ASBV	yfd ASBV	yss ASBV	ywec ASBV	nlw ASBV	ebwr ASBV	ebwr Records	ebcov ASBV	ldag ASBV	ldag Records	FPP ASBV	MPP ASBV	DPP ASBV
2000	4,926	2.1	1.8	0.0	0.0	6.8	5.2	8.9	-0.3	0.8	2.6	0.74	-0.4		-0.1	0.0		115	120	122
2002	10,757	2.3	1.9	0.0	0.1	6.8	4.7	8.7	-0.6	0.0	8.6	-0.09	-0.3		0.0	0.0		118	123	124
2004	9,857	3.5	3.2	0.2	0.5	7.1	4.4	8.6	-0.4	0.3	9.7	0.99	-0.3		-0.1	0.0		118	125	130
2006	9,067	4.0	3.7	0.2	0.5	7.2	4.4	8.3	-0.5	0.3	-13.0	1.91	-0.3	1,558	-0.1	0.1		119	127	131
2008	9,039	4.1	3.7	0.3	0.6	7.1	4.2	8.3	-0.5	0.5	-3.7	1.02	-0.3	2,244	-0.1	0.0	863	120	127	132
2010	13,865	4.8	4.0	0.3	0.6	8.0	4.6	8.8	-0.6	0.0	-9.8	0.16	-0.3	3,112	-0.1	0.0	482	122	129	133
2012	16,036	4.8	4.1	0.3	0.6	8.5	5.0	9.2	-0.7	0.7	-15.5	1.76	-0.4	4,726	-0.1	0.0	688	126	133	137
2014	25,485	4.5	3.7	0.2	0.4	9.4	6.2	10.8	-0.8	0.5	-18.0	1.40	-0.4	1,909	-0.2	-0.1	271	129	136	138
2016	26,216	4.8	3.9	0.1	0.4	10.6	7.5	12.5	-0.8	0.4	-22.5	-0.02	-0.4	504	-0.1	0.0		129	138	140
2018	29,260	5.7	4.8	0.2	0.4	13.0	9.4	15.2	-0.7	0.3	-18.7	0.63	-0.4	3,366	-0.1	0.0	234	133	144	147

Abbreviations; ywt Yearling Body Weight; awt Adult Body Weight; yfat Yearling Fat; yemd Yearling Eye Muscle Depth; ygfw Yearling Greasy Fleece Weight; agfw Adult Greasy Fleece Weight; acfw Adult Clean Fleece Weight; yfd Yearling Fibre Diameter; yss Yearling Staple Strength; ywec Yearling Worm Egg Count; nlw Number of Lambs Weaned; ebwr Early Breech Wrinkle; ebcov Early Breech Cover; ldag Late Dag; FPP Fibre Production Plus Index; MMP Merino Production Plus Index; DPP Dual Purpose Plus Index.

Source MERINOSELECT

Table 2 MERINOSELECT ASBV Percentiles (21st April 2020)																	
Percentile	ywt	awt	ycf	yemd	ygfw	agfw	acfw	yfd	yss	ywec	nlw	ebwr	ebcov	ldag	FPP	MPP	DPP
Band	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV	ASBV
%	kg	kg	mm	mm	%	%	%	micron	N/Kt	%	%	score	score	score	index	index	index
Top Value	19.9	21.9	7.1	5.0	49.5	39.7	51.1	-6.1	14.7	-95	25	-1.7	-1.5	-0.8	201	224	243
Top 1%	11.9	11.4	2.0	3.0	30.2	25.1	33.1	-3.3	7.0	-83	15	-1.2	-0.8	-0.4	172	188	194
Top 5%	9.8	9.1	1.4	2.3	24.8	20.4	27.8	-2.5	5.0	-63	10	-0.9	-0.6	-0.3	161	174	178
Top 10%	8.7	8.0	1.1	1.9	22.0	18.0	24.8	-2.2	3.9	-52	7	-0.8	-0.4	-0.3	155	166	169
Top 20%	7.3	6.6	0.8	1.4	18.5	14.8	21.0	-1.8	2.7	-40	5	-0.6	-0.3	-0.2	148	158	159
Top 30%	6.4	5.6	0.5	1.0	15.9	12.4	18.2	-1.5	1.9	-32	3	-0.5	-0.2	-0.2	143	152	153
Top 40%	5.5	4.7	0.3	0.6	13.6	10.3	15.7	-1.2	1.2	-24	2	-0.3	-0.2	-0.1	139	147	148
Top 50%	4.8	3.9	0.1	0.4	11.4	8.3	13.2	-1.0	0.6	-16	1	-0.2	-0.1	-0.1	135	143	143
Top 60%	4.0	3.1	-0.1	0.1	9.2	6.2	10.8	-0.8	-0.1	-8	0	-0.1	0.0	0.0	132	138	139
Top 70%	3.1	2.3	-0.3	-0.2	6.8	4.0	8.2	-0.6	-0.8	-1	-2	0.0	0.0	0.0	128	133	134
Top 80%	2.1	1.2	-0.5	-0.5	4.0	1.4	5.1	-0.3	-1.6	10	-3	0.2	0.1	0.1	123	127	129
Top 90%	0.7	-0.2	-0.8	-0.9	-0.1	-2.2	0.8	0.2	-2.8	28	-5	0.4	0.2	0.2	115	119	121
Source MERINOSELECT																	