

MERINOSELECT indexes

A ram breeder's guide

Why use a selection index?

A selection index is an important tool to drive genetic improvement in ram breeding programs when there are a range of traits of economic or functional importance. Collectively, these traits make up the “breeding objective”, which aims to improve profitability in commercial sheep enterprises.

Indexes are useful for two main reasons:

1. They balance genetic improvement appropriately across a range of traits, with the emphasis placed on each individual trait determined by its relative importance.
2. Because indexes balance improvement across traits, they can be used to overcome economically antagonistic relationships *between* traits.

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Appropriately designed indexes are central to the goal of breeding more profitable sheep for your ram buying clients.

How Sheep Genetics develops selection indexes

When Sheep Genetics develops standard selection indexes, a breeding objective is defined for each breeding scenario. This involves an analysis of commercial flock production data to calculate the economic value of improving traits which affect profit, based on flock structure, production and price data.

The second step is to translate the breeding objective into the index by linking profit traits to ASBV traits through genetic correlations. Often the profit and ASBV traits are the same, for example fleece weight, fibre diameter and body weight are key profit drivers in commercial Merino flocks and are also easy to measure in ram breeding flocks. For profit traits which are hard to measure however, we may rely on other correlated traits to drive improvement in the objective. An example of this is using breech wrinkle to reduce susceptibility to fly strike. More recently, genomic information has become increasingly important for genetic improvement of these hard to measure traits.

By combining the economic values of traits with the genetic relationships between traits we can determine the appropriate relative weights which allow us to combine ASBVs into a single index value for each animal.

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The changes in individual traits from using an index depend on the information you record in your flock. If you want to improve, or even just maintain a trait, you must record it to ensure ASBVs are sufficiently accurate for the index to do its job.

MERINOSELECT indexes

MERINOSELECT has standard indexes for three general production systems:

- Fibre Production (FP and FP+)
- Merino Production (MP and MP+)
- Dual Purpose (DP and DP+).

For each production system there are “base” and “plus” indexes, with the latter including ASBVs for more traits. Ram breeders can use either index, with the choice coming down to preferences regarding the balance of traits in the base and plus indexes, and whether the extra traits in the plus indexes are important to your breeding program. It is also important to keep in mind that the plus indexes are a more accurate reflection of the overall breeding objective for each production system.



Fibre Production (FP and FP+)

Summary of Fibre Production indexes

- The Fibre Production indexes are based on a production system where the majority of income is from the wool clip, with a focus on wool quality.
- FP focuses on genetic improvement of fleece weight and fibre diameter.
- FP+ additionally includes staple strength, worm resistance and reproduction.

Production system outline

This production system is for a self-replacing Merino flock where the majority of income is from the wool clip. There is a special focus on wool quality, with strong emphasis on reducing fibre diameter (mean and CV) in both indexes, and on increasing staple strength in the

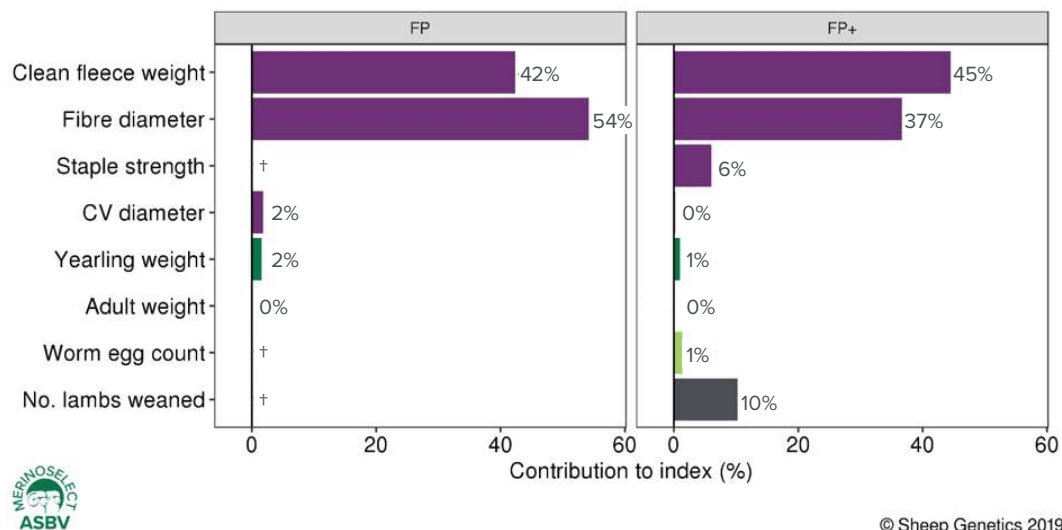
plus index. As this production system is commonly used in high rainfall zones where internal parasites cause significant economic losses, worm egg count is included in the plus index.

Trait contributions

Figure 1 illustrates which traits are in each index and how much they contribute to the overall balance of the indexes in the top 10% of current progeny. The longer the bar, the greater the impact on the index, and the greater the impact on the profitability of the production system.

In both FP and FP+, clean fleece weight and fibre diameter are the traits that contribute most to the profitability of the production system. The main difference is the increased contribution from staple strength, worm egg count and number of lambs weaned in the FP+ index.

Figure 1: The traits in the FP and FP+ indexes and how they contribute to the overall balance of the indexes in the top 10% of current progeny



Selection advantage

Table 1 shows the selection advantage for the top 10% of current progeny selected on each index. The numbers show how much better the ASBVs of the top 10% are compared to the average of the drop. For example, ASBVs for clean fleece weight for the top 10% of progeny on FP+ are 6.7% higher than the average of the drop.

Both indexes show similar selection advantages for fleece weight and fibre diameter, but that selection on the FP index results in reductions in staple strength and number of lambs weaned, and higher worm egg counts, because these traits are not included in the index. If these traits are important to your breeding program, the FP+ index may be a better option. Note also that while worm egg count in the FP+ index is in the desired (negative) direction, the selection advantage is small. In flocks with a strong focus on this trait, there are larger selection advantages.

Table 1: The selection advantage for the top 10% of the current progeny drop selected on the FP and FP+ indexes

	FP	FP+
Clean fleece weight (%)	6.3	6.7
Fibre diameter (μm)	-0.7	-0.5
Staple strength (NKTex)	-0.6 [†]	0.6
CV diameter (%)	0.0	0.0
Yearling weight (kg)	0.5	0.7
Adult weight (kg)	0.1	0.3
Worm egg count (%)	7.4 [†]	-1.8
No. lambs weaned (%)	-1.3 [†]	2.1
[†] Trait not in index		

When selecting on the FP and FP+ indexes, long-term responses in individual traits will vary depending on features of the breeding program, including traits measured, level of pedigree recording, use of genomic testing, flock structure and selection emphasis on the index. The selection advantages shown in table 1 give an indication of the likely direction and relativity of responses for the FP and FP+ indexes.



Merino Production (MP and MP+)

Summary of Merino Production indexes

- The Merino Production indexes are based on a production system where the income is a combination of wool and surplus sheep sales.
- The MP index focuses on genetic improvement of fleece weight, fibre diameter and body weight.
- The MP+ index additionally includes staple strength and reproduction.

Production system outline

This production system is for a self-replacing Merino flock where the income is a combination of wool and surplus sheep sales. Improvement of wool income is focused on a balance of increasing fleece weight and reducing fibre diameter, with a small level of emphasis on maintaining or slightly increasing staple strength in

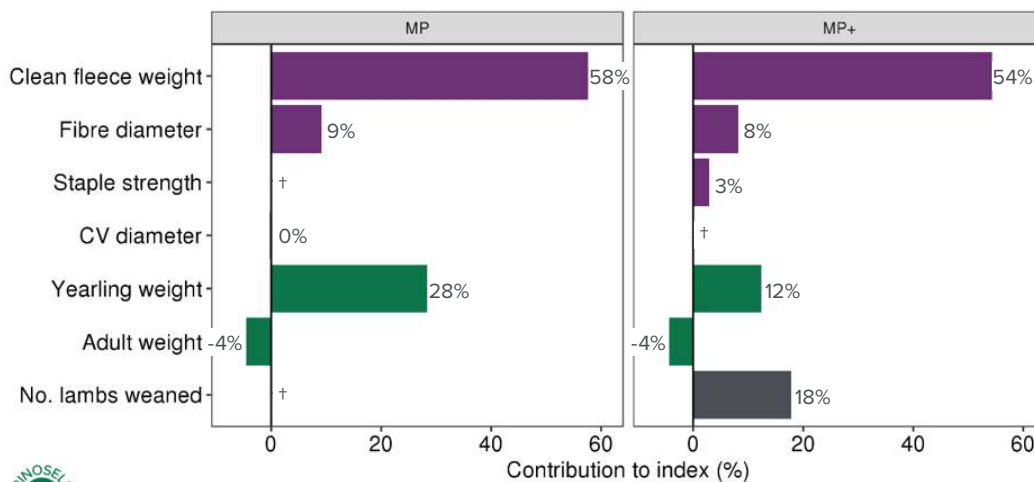
increasing staple strength in the MP+ index. Surplus young sheep, which are all straight-bred Merino, are sold as yearlings.

Trait contributions

Figure 2 illustrates which traits are in each index and how much they contribute to the overall balance of the indexes in the top 10% of current progeny. The longer the bar, the greater the impact on the index, and the greater impact on the profitability of the production system.

In both MP and MP+, fleece weight contributes the most to the profitability of the production system. The main difference is the contribution of staple strength and number of lambs weaned in the MP+ index. Adult weight makes a small negative contribution to the index when considered on its own because bigger ewes have higher feed costs. However, bigger ewes also produce more lambs which reach sale weight faster, so the index makes a trade-off to achieve an optimal balance across all traits.

Figure 2: The traits in the MP and MP+ indexes and how they contribute to the overall balance of the indexes in the top 10% of current progeny



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Selection advantage

Table 2 shows the selection advantage for the top 10% of current progeny selected on each index.

The numbers show how much better the ASBVs of the top 10% are compared to the average of the drop. For example, ASBVs for clean fleece weight for the top 10% of progeny on both MP and MP+ are 9.4% higher than the average of the drop. The two indexes show the same selection advantages for fleece weight and fibre diameter, but selection on the MP index results in a reduction in staple strength and a lower (but still positive) advantage in number of lambs weaned because these traits are not included in the index. The MP index is able to achieve a small positive advantage in number of lambs weaned by placing more selection emphasis on yearling and adult weight. The MP+ index gives greater control in balancing increased adult weight with higher reproduction.

Table 2: The selection advantage for the top 10% of the current progeny drop selected on the MP and MP+ indexes

	MP	MP+
Clean fleece weight (%)	9.4	9.4
Fibre diameter	-0.2	-0.2
Staple strength (NKTex)	-0.3 [†]	0.4
CV diameter (%)	0.0	0.1 [†]
Yearling weight (kg)	2.4	1.6
Adult weight (kg)	1.8	1.1
No. lambs weaned (%)	0.9 [†]	3.2

[†] Trait not in index

When selecting on the MP and MP+ indexes, long-term responses in individual traits will vary depending on features of the breeding program including traits measured, level of pedigree recording, use of genomic testing, flock structure and selection emphasis on the index. The selection advantages shown in table 2 give an indication of the likely direction and relativity of responses for the MP and MP+ indexes.



Dual Purpose (DP and DP+)

Summary of Dual Purpose indexes

- The Dual Purpose indexes target production systems with a balance of income from wool from Merinos and meat production from lambs by terminal sires.
- The DP index focuses on the genetic improvement of fleece weight and body weight.
- The DP+ index additionally includes reproduction, carcase traits and staple strength.

Production system outline

This production system is for self-replacing Merino flocks with a greater focus on lamb production, with a portion of the ewe flock mated to terminal sires to generate crossbred lambs for meat production. This means that there is greater emphasis on growth, carcase performance and reproduction to capitalise on the high value of lambs and to ensure that flock size is sustainable while joining to terminal sires. Wool production is still important, but the balance is on increasing fleece weight while trying to limit change in fibre diameter and staple strength.

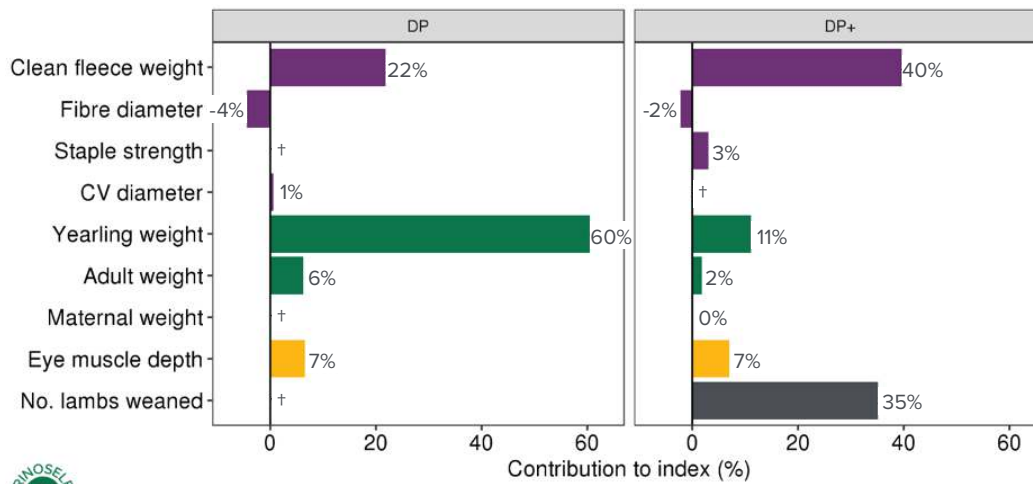
Trait contributions

Figure 3 illustrates which traits are in each index and how much they contribute to the overall balance of the index in the top 10% of current progeny. The longer the bar the greater the impact on the index, and the greater impact on the profitability of the production system outlined above.

In both indexes fleece weight, yearling weight and eye muscle depth are traits that contribute significantly to the index. The main difference between the two indexes is the high contribution from number of lambs weaned in the DP+ index. There is also a small favourable contribution from staple strength in DP+.

The breeding objective for the DP indexes aims to maximise the increase in fleece weight while maintaining fibre diameter at a constant level. In some circumstances use of the DP indexes leads to small increases in fibre diameter, reflected as negative index contributions shown in figure 3. If this issue is important in your flock, ASBVs for fibre diameter should be considered in conjunction with the indexes.

Figure 3: The traits in the DP and DP+ indexes and how they contribute to the overall balance of the indexes in the top 10% of current progeny



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Selection advantage

Table 3 shows the selection advantage for the top 10% of current progeny selected on each index. The numbers show how much better the ASBVs of the top 10% are compared to the average of the drop. For example, ASBVs for clean fleece weight for the top 10% of progeny on DP+ are 7.6% higher than the average of the drop.

The DP index shows high selection advantages for yearling and adult weight, and fleece weight. The DP+ index shows a strong advantage in number of lambs weaned, higher clean fleece weight, and lower body weight. The advantages in staple strength and to a lesser degree eye muscle depth are also greater for DP+. As seen in the graphs above, fibre diameter increases leading to negative overall impacts on both indexes, but the size of the changes is small.

Table 3: The selection advantage for the top 10% of the current progeny drop selected on the DP and DP+ indexes

	DP	DP+
Clean fleece weight (%)	5.7	7.6
Fibre diameter	0.2	0.1
Staple strength (NKTex)	-0.1 [†]	0.6
CV diameter (%)	-0.1	-0.1 [†]
Yearling weight (kg)	4.1	2.5
Adult weight (kg)	3.8	2.1
Maternal weight (kg)	-0.2 [†]	-0.1
Eye muscle depth (mm)	0.2	0.3
No. lambs weaned (%)	0.7 [†]	4.7

[†] Trait not in index

When selecting on the DP and DP+ indexes, long-term responses in individual traits will vary depending on features of the breeding program including traits measured, level of pedigree recording, use of genomic testing, flock structure and selection emphasis on the index. The selection advantages shown in table 3 give an indication of the likely direction and relativity of responses for the DP and DP+ indexes.



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More information

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