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Meat Standards Australia
Breeding for Improved MSA Compliance & Increased MSA Index Values

Meat Standards Australia (MSA), an eating quality grading system for Australian beef and sheep meat, has continued to grow in recent times with more than 3 million cattle being presented for grading using MSA standards and pathways during the 2013-14 financial year.

The increase in cattle numbers is complemented by strong growth in MSA producer registrations, processor uptake and expansion, as well as an increase in consumer awareness of MSA.

Over 40 processors are now grading MSA beef, with prices received for MSA yearling cattle being consistently higher than non-MSA cattle. During the 2013-14 financial year, the average premium for MSA yearling cattle in NSW and Queensland, across all weight ranges, was $0.29/kg, representing a valuable opportunity for producers supplying these markets.

Breeding for MSA Programs

There are many factors which affect the suitability of an individual carcase for MSA programs. While many of these factors are heavily influenced by animal handling and management on-farm, during transport and at the abattoir, several components are also influenced by the genetics of the animal.

Opportunities consequently exist to improve the suitability of animals for marketing into MSA programs through the adoption of suitable breeding and selection strategies.

Understanding MSA Compliance

Cattle consigned to MSA must comply with a number of minimum grading specifications; otherwise they will be downgraded to non-MSA product and won't receive a premium.

To be considered MSA compliant, carcases must meet the following specifications:

- AUSMEAT Meat Colour Score of 1B to 3
- Muscle pH of equal to or less than 5.70
- Minimum rib fat of 3mm
- Adequate fat coverage over the entire carcase

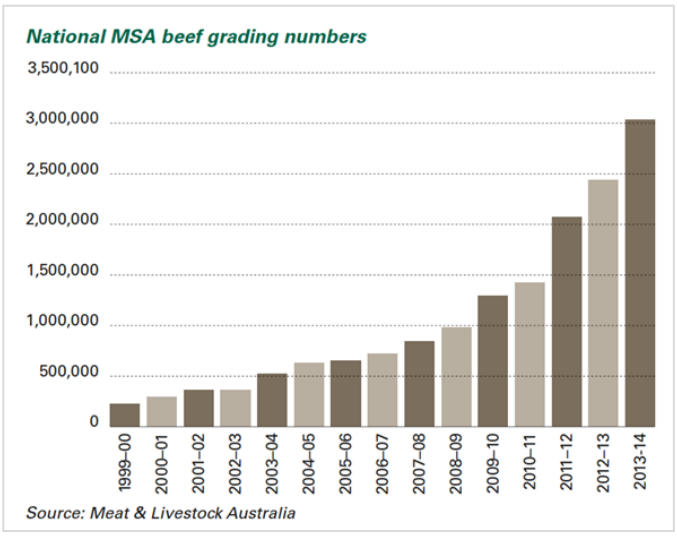


Figure 1: More than 3 million cattle were presented for grading using MSA standards and pathways during the 2013-14 financial year

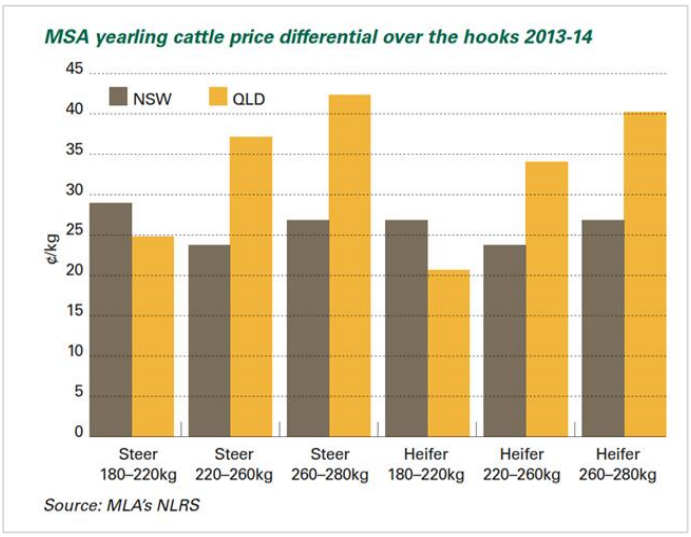


Figure 2: During the 2013-14 financial year, the average premium for MSA yearling cattle in NSW and Queensland was $0.29/kg.

Carcases graded during 2013-14 across Australia achieved 92.6% compliance to MSA specifications. Meat colour, and to a slightly lesser extent pH, were the greatest reasons for non-compliance. Only a small percentage of carcases did not meet the minimum MSA requirement of 3mm rib fat.

In addition to MSA specifications, some processors and brands impose further specifications based on their own market requirements. For example, processors may have specifications around carcase weight, dentition and fat colour. Throughout 2013-14, an additional 7% of MSA graded cattle did not meet company specifications.

Selecting Genetics for Improved MSA Compliance

The different components affecting whether carcases meet MSA compliance specifications are all influenced to some extent by genetics and can be improved through the selection of animals with appropriate genetics.

1. Meat Colour & pH

Dark meat colour (ie. over an AUSMEAT score of 3), commonly referred to as 'dark cutting', is associated with low muscle glycogen levels in the live animal prior to slaughter, thus resulting in an unappealing product for consumers. Similarly, if there is only a small amount of muscle glycogen present pre-slaughter, pH may not decline to the required level.

Maintaining glycogen levels pre-slaughter is consequently of utmost importance and can be achieved by minimising stress and/or activity both on-farm and in the lead up to slaughter. Cattle with poor temperament have an adverse effect on the cattle around them, all of which results in higher pH carcases and a higher incidence of dark cutting.

Selection for improved temperament can be achieved by ensuring that all animals used in a breeding program have acceptable temperament, and when available, selecting animals with superior Docility EBVs. Docility EBVs are estimates of genetic differences in the percentage of an animal's progeny that will be scored with acceptable temperament, with higher EBVs associated with superior temperament. For example, an animal with an EBV of +20% would be expected to on average produce a greater percentage of progeny that have acceptable temperament than a bull with an EBV of –2%.

Research has also demonstrated that animals with higher muscle content, as defined by size of

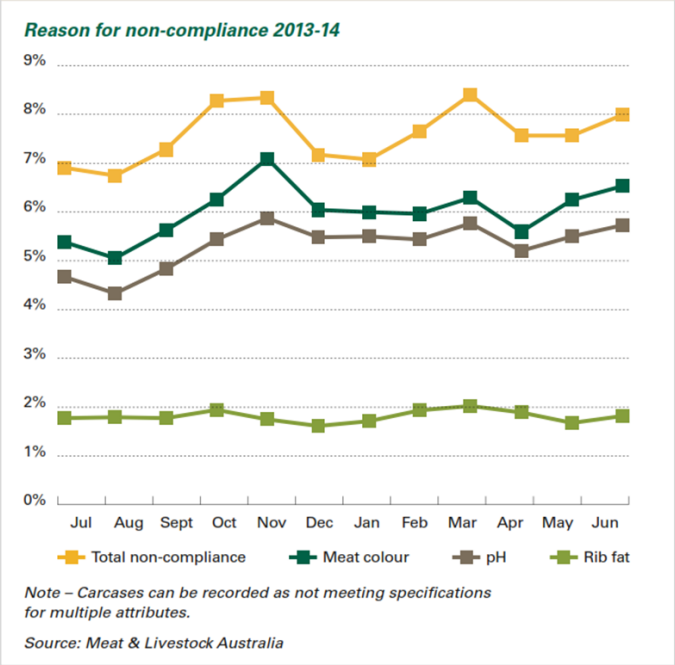


Figure 3: Carcases graded during 2013-14 across Australia achieved 92.6% compliance to MSA specifications. Meat colour, and to a slightly lesser extent pH, were the greatest reasons for non-compliance.

carcass eye muscle area (EMA) adjusted for hot standard carcass weight, is strongly associated with reduced incidence of dark cutting. A reduction in the incidence of dark cutting in high muscled cattle also complements the other advantages of muscular cattle, such as increased retail beef yield and processing efficiency.

Selection for increased muscle content in a standard weight carcase can be achieved by selection of animals with higher EMA EBVs. EMA EBVs are estimates of the genetic differences between animals in eye muscle area at the 12/13th rib site in a standard weight steer carcase, with higher EBVs associated with larger eye muscle area. For example, an animal with an EMA EBV of +4.4 mm would be expected to produce calves with larger eye muscle area than an animal with an EMA EBV of +1.0 mm, relative to carcase weight.

2. Rib Fat Thickness & Fat Distribution

Rib fat thickness is the measured depth of subcutaneous fat over the quartered rib site between the 5th and 13th ribs. A covering of fat is needed to protect the high value primal cuts from rapid chilling, which can cause toughening, and to enhance eating quality and appearance.

In addition to minimum fat levels, a key requirement for all beef markets is to have adequate cover over the high-value cuts along the loin (back) and rump. MSA requires carcases to

have adequate fat coverage over all major primals, with an area of inadequate fat distribution not being greater than 10cm x 10cm over each individual primal.

Selection for adequate rib fat and fat distribution can be achieved by selection of animals with appropriate Rib and Rump Fat EBVs. Rib and Rump Fat EBVs are estimates of the genetic differences between animals in fat depth at the 12/13th rib and P8 rump site respectively in a standard weight steer carcase, with higher EBVs associated with greater fat depth. For example, an animal with a Rib Fat EBV of +0.4 mm would be expected to produce calves with more fat than an animal with a Rib Fat EBV of -0.6 mm, relative to carcase weight.

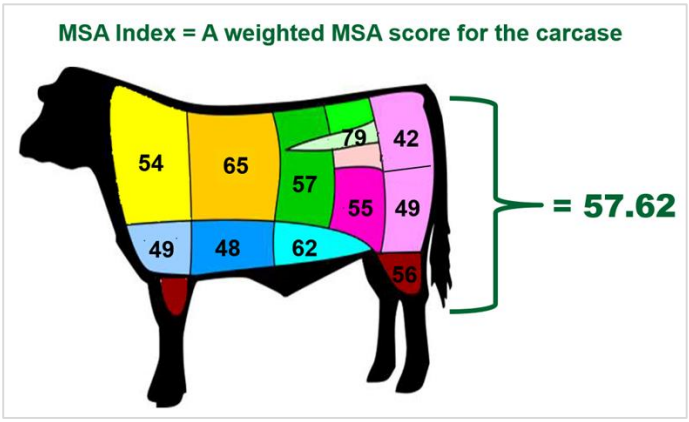
Breeding for Increased MSA Index Values

In addition to MSA compliance, all animals meeting MSA grading specifications are now provided with MSA Index values, and increasingly processors are offering additional price premiums for animals with superior MSA Indexes.

Understanding MSA Index

The Meat Standards Australia (MSA) Index, expressed as a single number ranging from 30 to 80, predicts the eating quality of an individual beef carcase. A higher MSA Index indicates that the carcase has a higher predicted eating quality.

The MSA Index value that a carcase receives is based on the eating quality of 39 different cut by cook combinations, weighted to account for the differences in the percentage of the total carcase that each cut represents. The MSA index is independent of any processing inputs and is calculated using only attributes influenced by pre-slaughter production.

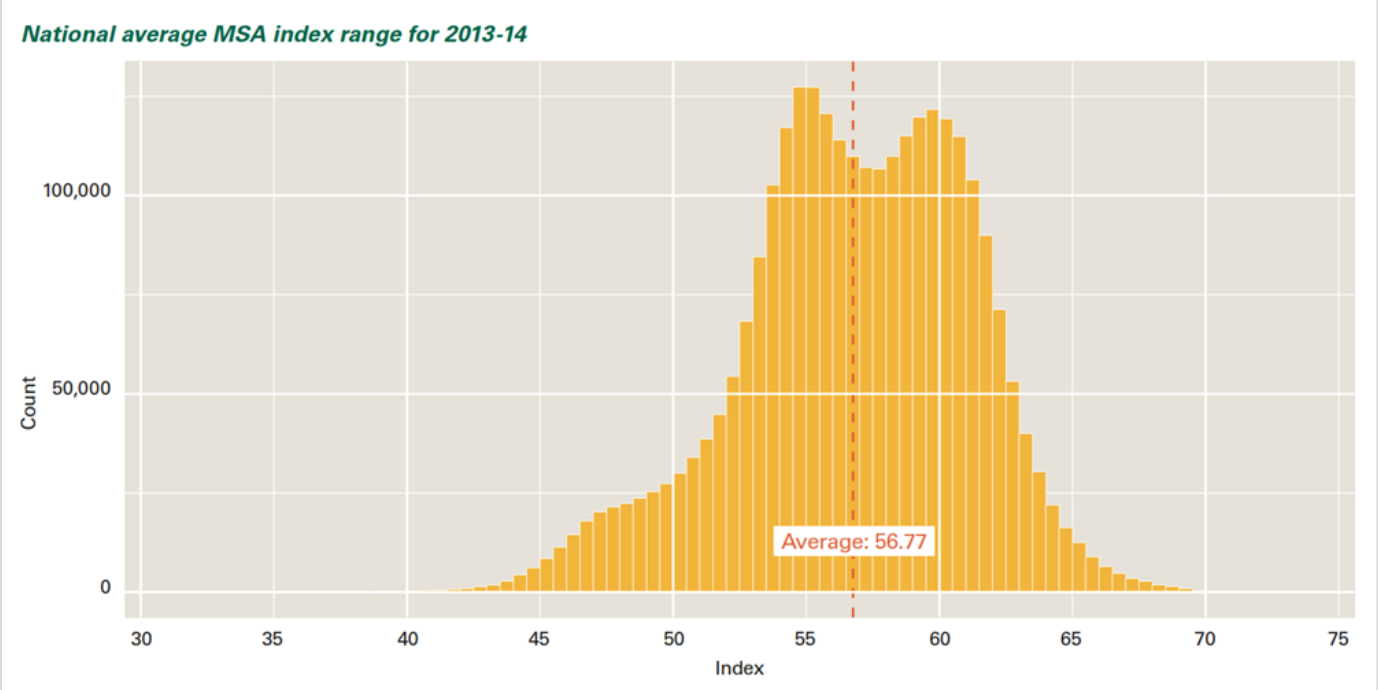


The MSA Index provides beef producers with an opportunity to benchmark the impact of genetic and management changes on their herd's predicted eating quality across time, even when they are processed in different locations, by different processors, or at different times. In situations where a premium is paid for carcases with superior eating quality, the MSA Index also provides a valuable opportunity to increase sale price.

Factors Underlying the MSA Index

The key factors impacting on eating quality that are influenced by the producer include:

- Tropical breed content, verified or determined by hump height measurement
- MSA Marbling Score
- Ossification
- Hormonal Growth Promotant (HGP) Status
- Milk Fed Vealer Category
- Saleyard Status
- Rib Fat
- Hot Standard Carcase Weight (HSCW)
- Sex



The effect that each of the individual factors has on MSA Index varies. Whether an animal has been treated with an HGP, whether an animal is a milk fed vealer and/or whether an animal has been sold directly to slaughter have a very high impact on the overall MSA Index value of a carcase, followed by MSA Marble Score, hump height, tropical breed content and ossification. Rib fat, HSCW and Sex have relatively lower impacts on the overall MSA Index value.

Selecting Genetics to Improve MSA Index Score

Whilst many of the factors that affect the MSA Index are heavily influenced by animal management and handling, in a similar fashion to improved MSA compliance, there is also an opportunity to increase MSA Index values through genetic selection.

1. Marbling

MSA Marble Score is an assessment of the intramuscular fat deposits at the quartered site between the 5th and 13th ribs. MSA Marble Score provides an indication of the distribution and piece size, as well as the amount of marbling. MSA marble scores range from 100 to 1190 in increments of 10, with higher scores indicating greater marbling.

As MSA Marble Score increases by 10, the MSA Index has the potential to increase by 0.15 Index units, or rather an increase in MSA Marble Score of 100 (roughly equivalent to a 1 unit increase in AUSMEAT marble score) equates to a 1.5 unit increase in MSA Index.

Selection for improved MSA marble score can be achieved by selecting animals with higher Intramuscular Fat (IMF) EBVs. Intramuscular Fat

Carcase input	Size of effect on the MSA Index (units)	Clarification of effect	Relative importance of these traits in changing the MSA Index*
HGP status	5	The MSA Index of carcases with **no** HGP implant is around 5 Index units higher	**Very High**
Milk-fed vealer	4	The MSA Index of milk fed vealer carcases is around 4 index units higher	**Very High**
Saleyard	5	Carcases which were consigned directly to slaughter and NOT processed through a saleyard have an MSA Index around 5 index units higher	**Very High**
MSA marbling	0.15	As MSA marbling score increases by 10, the MSA Index increases by around 0.15 index units	**High**
Hump height (for cattle greater than 0% TBC)**	-0.7	As hump height increases by 10mm, the MSA Index decreases by around 0.7 units In carcases which have no TBC, hump height has no impact on MSA Index	**High**
Tropical Breed Content (TBC)**	0% = 0 12% = -1.6 18% = -3.2 25% = -3.9 38% = -4.7 50% = -5.2 75% = -5.5 100% = -6.3	As declared TBC content increases from 0 to 100%, the MSA Index decreases by up to 6.3 units	**High**
Ossification score	0.6	As ossification score decreases by 10, the MSA Index increases by 0.6 index units	**High**
Rib fat	0.1	As rib fat increases by 1 mm, the MSA Index increases by 0.1 index units	Medium
Hot standard carcase weight (HSCW)	0.01	As HSCW increases by 1kg, the MSA Index increases by <0.01 index units	Low
Sex	0.3	With low ossification values, females have a higher index value than steers by around 0.3 index units	Low

Figure 4: The effect of different carcase attributes on MSA Index

EBVs are estimates of genetic differences between animals in intramuscular fat at the 12/13th rib site in a standard weight steer carcase, with higher IMF EBVs associated with greater marbling in the carcase. For example, an animal with an IMF EBV of +2.9% would be expected to produce progeny with more marbling in a standard carcase than the progeny of an animal with an IMF EBV of +0.2%.

2. Ossification

Ossification is the process whereby the cartilage present around the bones changes into bone as the animal matures, and is a measure of the physiological maturity of the carcase. Although it can be roughly associated with the animal's chronological age, ossification takes into account the entire developmental lifespan of the animal which may be affected by nutrition, sickness and/or temperament. Ossification scores range from 100 to 590 in increments of 10, with lower scores indicating less physiological maturity.

As ossification score decreases by 10, the MSA Index potentially increases by 0.6 Index units, or rather, a decrease in ossification score of 100 equates to an increase in MSA Index of 6 units. Therefore, younger animals with lower levels of ossification tend to have a higher MSA index values than older animals with higher ossification values.

Selection for lower ossification scores can be achieved by selecting animals with higher 200 Day Growth, 400 Day Weight and 600 Day Weight EBVs, as calves which grow more quickly will reach target live weights at a younger age with lower ossification score. 200 Day Growth EBV, 400 Day Weight EBV and 600 Day Weight EBV estimate the genetic differences between animals in live weight at 200, 400 and 600 days respectively due to an animal's growth genetics. In all three cases, higher EBVs are associated with heavier weights at the respective age. For example, an animal with a 400 Day Weight EBV of +60 kg would be expected to produce heavier progeny at 400 days of age than an animal with a 400 Day Weight EBV of +20 kg.

3. Rib Fat

Whilst of utmost importance in determining whether carcases are compliant to MSA specifications, rib fat thickness also has an impact on MSA Index.

A 1mm increase in rib fat corresponds to a potential increase in the MSA Index of 0.1 Index units, or rather, an increase of 10mm in fat depth equates to an increase in MSA Index of 1 unit.

Selection for increased rib fat can be achieved by selection of animals with higher Rib Fat EBVs. Rib Fat EBVs are estimates of the genetic differences between animals in fat depth at the 12/13th rib site in a standard weight steer carcase, with higher EBVs associated with greater fat depth.

Whilst a higher level of rib fat is favourable for superior eating quality and MSA index, this benefit

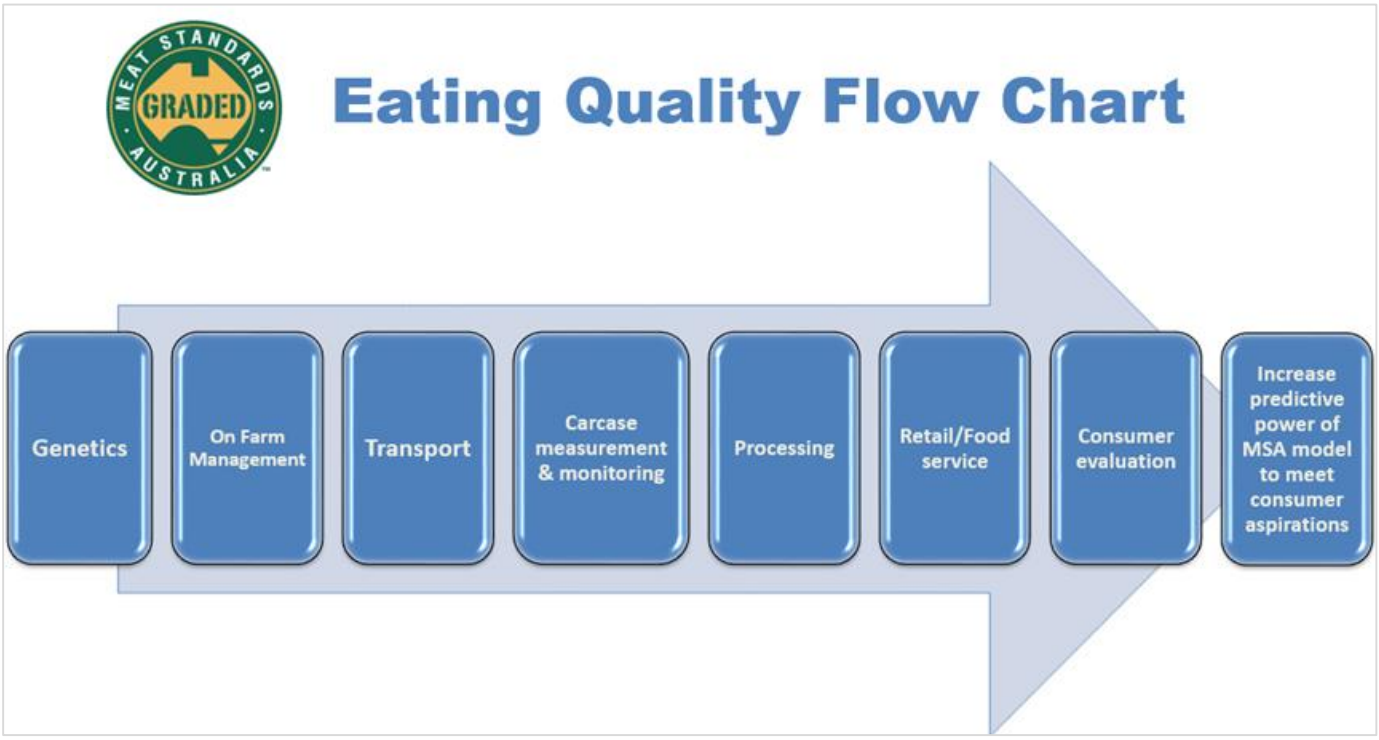


Figure 5: Genetics is an important factor contributing to the overall eating quality of a beef carcase

needs to be balanced with the negative effect that higher levels of rib fat may have on carcase yield.

4. Carcase Weight

Whilst an important specification in most livestock grids, carcase weight only has a small impact on MSA Index, with MSA calculating that as HSCW increases by 1kg, the MSA Index will potentially increase by less than 0.01 Index units. In other words, an increase in HSCW of 100kg equates to an increase in MSA Index of 1 unit.

To select for heavier carcasses at the same maturity (ossification), animals with higher Carcase Weight EBVs should be selected.

Carcase Weight EBVs are estimates of the genetic differences between animals in hot standard carcase weight, with higher Carcase Weight EBVs associated with heavier carcases. For example, an animal with a Carcase Weight EBV of +60 kg would be expected to produce progeny with heavier carcases than an animal with a Carcase Weight EBV of +30 kg.

Take Home Messages

Whilst many of the factors that affect the eating quality of a carcase and its suitability for MSA programs are heavily influenced by animal handling and management, many factors are also influenced by the genetics of an animal.

Selection of animals with acceptable temperament, higher Docility EBVs, higher Eye Muscle Area EBVs and appropriate Rib & Rump Fat EBVs can improve MSA compliance, whilst selection of animals with higher IMF EBVs to increase marbling score, higher Growth EBVs to reduce ossification score, higher Rib Fat EBVs to increase carcase fatness and higher Carcase Weight EBVs to increase HSCW at the same maturity, will increase MSA Index values and thus increase the eating quality of your herd.

To improve:	Select for:
Meat Colour	Higher Docility and Eye Muscle Area EBVs
Rib Fat Thickness & Fat Distribution	Appropriate Rib and Rump Fat EBVs
Marbling	Higher Intramuscular Fat (IMF) EBVs
Ossification	Higher 200 Day Growth, 400 Day Weight and 600 Day Weight EBVs
Carcase Weight	Higher Carcase Weight EBVs

To further discuss breeding for MSA programs, please contact staff at Angus Australia. More information about Meat Standards Australia is also available from the MLA website (www.mla.com.au).

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Reference:
Meat & Livestock Australia, Meat Standards Australia Annual Outcomes Report 2013-14
Jessira Perovic, MLA, Presentation at Angus Breed Development Conference, Armidale, April 2015
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