CAPITALISING ON THE GENETIC VARIATION BETWEEN ANGUS ANIMALS

MEAT & LIVESTOCK AUSTRALIA

The Angus Sire Benchmarking Program (ASBP) has demonstrated that there is great potential to achieve genetic improvement in Angus breeding programs by capitalising on the genetic variation that exists between Angus animals.

A recent project undertaken by Angus Australia assessed the variation in the average performance of progeny from sires in cohorts 1, 2 and 3 of the ASBP.

This project has illustrated the considerable genetic variation that can be found between Angus animals and the opportunity that consequently exists to improve the productivity and profitability of Angus beef breeding enterprises by utilising superior genetics.

This resource were created as a result of a collaboration between Angus Australia and Meat & Livestock Australia Donor Company (MDC) (Project P.PSH.1063).

BACKGROUND

The Angus Sire Benchmarking Program is an initiative of Angus Australia that aims to:

a) generate progeny test data on modern Angus bulls, particularly for hard to measure traits such as feed efficiency, abattoir carcase measurement, meat quality attributes and female reproduction;
b) generate data for the validation and refinement of Angus BREEDPLAN; and
c) build a comprehensive phenotype and genotype database on Australian Angus animals for genomic technology validation, research and development.

Within each cohort of the ASBP, on average, 40 sires are joined each year to approximately 2000 Angus cows to produce 25 progeny (50:50 steers and heifers) per sire using fixed time AI. In this program, the progeny of each sire are comprehensively performance recorded across a range of traits relating to fertility, weight, feed efficiency and carcase merit.

PROJECT DESIGN

To evaluate the difference in the average progeny performance of high and low performing sires within each cohort of the ASBP, progeny performance data was collected for all major traits and the standard BREEDPLAN adjustments and contemporary groupings applied.

Performance data such as shear force, MSA index, MSA ossification and MSA marbling that are not included in the routine Angus BREEDPLAN analysis were split into the same contemporary groups as carcase weight.

The performance data was then analysed through the Statistical Analysis System (SAS) to generate least squares means (LSMs), being each sire's average progeny performance for each trait.

Once the sire LSMs were obtained, the average progeny performance for the highest five and lowest five performing sires in each cohort were calculated for each respective trait, followed by the conduct of a T-test to quantify whether the difference in progeny performance between the highest and lowest performing sires was statistically significant or not.

TRAITS ANALYSED

CALVING EASE AND FERTILITY	Birth Weight	Weight at birth in kilograms recorded on both steer and heifer progeny. Lower values indicate lighter birth weights.
	Days to Calving	Length of days from the start of joining (i.e. bull in date) to calving. This is recorded on the heifer progeny for their first joining as yearlings. Lower values indicate shorter days to calving and improved female reproduction.
	Gestation Length	Length of time in days from conception to birth recorded on both steer and heifer progeny. Lower values indicate shorter gestation lengths.

GROWTH	200 Day Weight	Weight at 200 days of age (i.e. weaning weight) in kilograms recorded on both steer and heifer progeny. Higher values indicate heavier weaning weights.
	400 Day Weight	Weight at 400 days of age (i.e. yearling weight) in kilograms recorded on both steer and heifer progeny. Higher values indicate heavier yearling weights.
	600 Day Weight	Weight at 600 days of age (i.e. 20 months) in kilograms recorded on both steer and heifer progeny. Higher values indicate heavier weights.

FEED EFFICIENCY	Net Feed Intake - Feedlot (NFI-F)	Feed intake at a standard weight and rate of weight gain recorded on steer progeny at Tullimba Research Feedlot. NFI is expressed as kilograms of feed intake per day, with lower values indicating better feed efficiency through less feed intake for the same weight and rate of weight gain.

CARCASE COMPOSITION	Carcase Weight	Weight of the hot standard carcase in kilograms at 750 days of age (i.e. 25 months) recorded on steer progeny. Higher values indicate heavier carcase weights.
	Carcase Eye Muscle Area (EMA)	Eye muscle area in cm2 in a 400 kg carcase measured on steer progeny. Higher values indicate larger eye muscle areas.
	Carcase Rump Fat	Subcutaneous fat measurement in mm at the P8 rump site in a 400 kg carcase measured on steer progeny. Higher values indicate more rump fat.
	Carcase Rib Fat	Subcutaneous fat measurement in mm at the 12th and 13th rib site in a 400 kg carcase measured on steer progeny. Higher values indicate more rib fat.
	Carcase Intra-muscular Fat (IMF)	Percentage of intramuscular fat (ether extracted at the UNE meat science laboratory) in a 400 kg carcase measured on steer progeny. Higher values indicate more intramuscular fat.

CARCASE QUALITY	Meat Standards Australia (MSA) Marbling Score	Marbling score recorded by the MSA grader in the chiller on steer progeny. Higher values indicate more marbling in the carcase.
	Meat Standards Australia (MSA) Ossification	Ossification score recorded by the MSA grader in the chiller on steer progeny. Lower values indicate younger physiological maturity and superior eating quality.
	Meat Standards Australia (MSA) Index	MSA Index recorded by the MSA grader in the chiller. MSA Index is an indication of the overall eating quality of beef from the carcase as influenced by a range of factors such as marbling score and ossification, with higher values indicating higher eating quality.
	Shear Force	Force required to pull a mechanical blade through a piece of cooked beef from the striploin sample of the steer progeny in kilograms. It is measured through the UNE meat science laboratory with lower values indicating less shear force and more tender beef.

DIFFERENCES IN PROGENY PERFORMANCE

BETWEEN HIGHEST AND LOWEST FIVE PERFORMING SIRES IN EACH COHORT

Calving Ease and Fertility (Birth Weight, Gestation Length, Days to Calving)
The progeny of the five sires in each cohort with the heaviest progeny at birth were on average 4.9 kilograms heavier when born than the progeny from the five sires with the lightest progeny at birth, whereas the progeny by the five sires in each cohort with the shortest gestation length were born on average 6.8 days earlier than progeny by the five sires with the longest gestation length.

Likewise, the daughters by the five sires with the shortest days to calving calved on average 37.1 days earlier than the daughters by the five sires with the longest days to calving in each respective cohort.

This indicates there is considerable potential to improve calving ease and female fertility through selection of Angus animals with superior genetics for these traits.

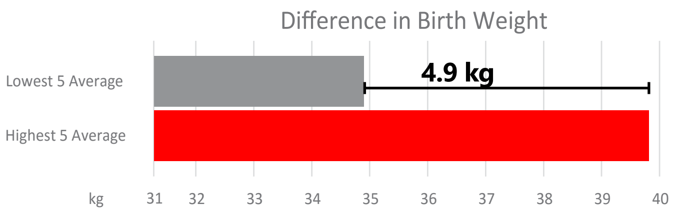
The following charts illustrate the variation between the lowest 5 and highest 5 animals averaged across all 3 cohorts, for each of the above mentioned traits.

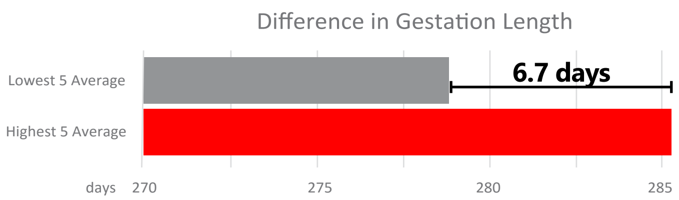
TABLE 1: Difference between average progeny performance of highest five and lowest five performing sires for birth and fertility traits

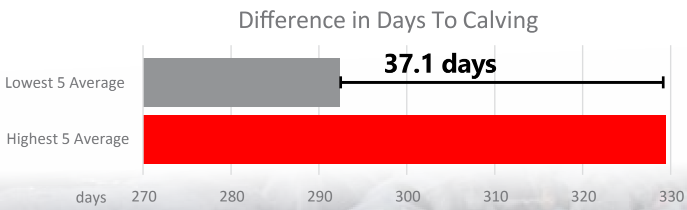
	Birth Weight	Gestation Length	Days to Calving
Cohort 1	4.4 kg	7.0 days	45.7 days
Cohort 2	4.8 kg	5.9 days	44.8 days
Cohort 3	5.5 kg	7.4 days	20.8 days
Average	4.9 kg	6.7 days	37.1 days

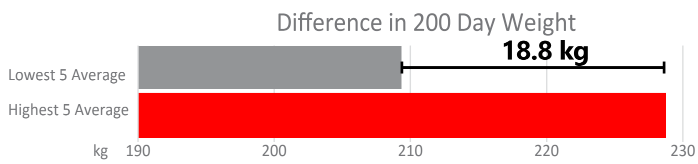
Growth (200, 400 and 600 Day Weights)
The progeny of the five sires in each cohort with the heaviest progeny at weaning were on average 18.8 kilograms heavier than the five sires with the lightest progeny at weaning. Similarly, progeny by the five sires with the heaviest 400 and 600 day weights were on average 34.9 kg and 43.8 kg heavier than progeny by the five sires with the lightest 400 and 600 day weights in each respective cohort.

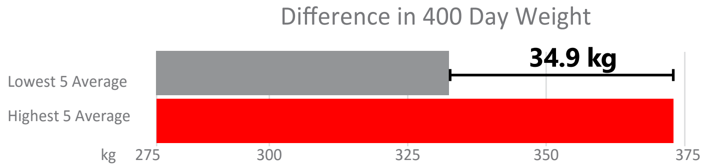
This variation indicates the considerable potential to improve the growth of animals at certain stages of development through selection of Angus animals with superior genetics for these traits, and ultimately to reduce the age at which sale progeny meet target weights.











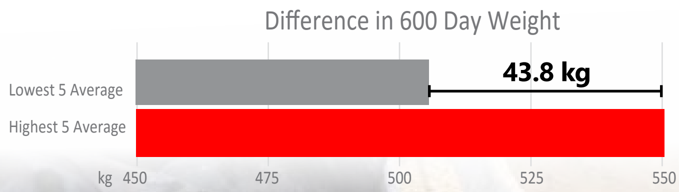


TABLE 2: Difference between average progeny performance of highest five and lowest five performing sires for growth traits (200, 400 and 600 days)

	200 Day Weight	400 Day Weight	600 Day Weight
Cohort 1	15.7 kg	28.4 kg	35.6 kg
Cohort 2	23.3 kg	35.0 kg	44.8 kg
Cohort 3	17.4 kg	41.3 kg	51.1 kg
Average	18.8 kg	34.9 kg	43.8 kg

Feed Efficiency (Net Feed Intake - Feedlot)

The difference in the net feed intake of progeny from the five sires with the lowest net feed intake and the five sires with the highest net feed intake across the first three cohorts of the ASBP was 1.51 kg/day, meaning that progeny of the most feed efficient five sires in each cohort consumed approximately 1.5 kg/day less than the five least efficient sires at the same weight and rate of weight gain.

This demonstrates the significant potential to increase the feed efficiency through selection of Angus animals with superior genetics for net feed intake.

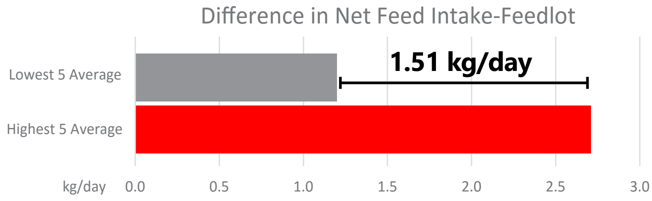
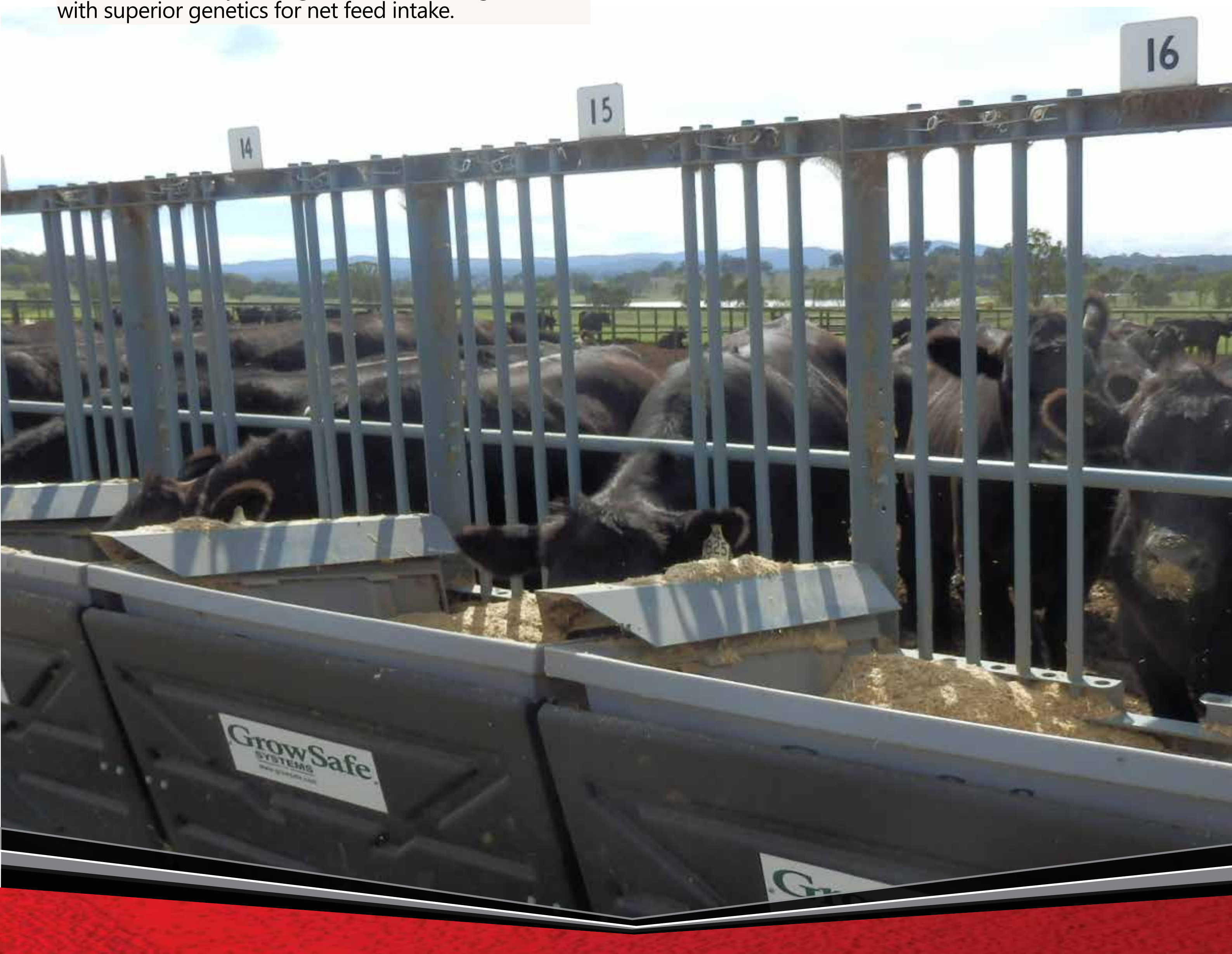


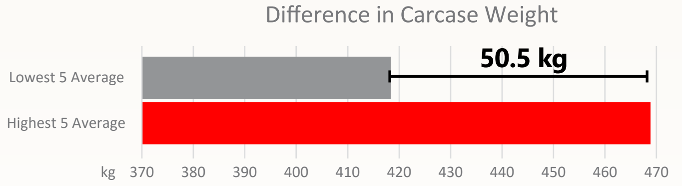
TABLE 3: Difference between average progeny performance of highest five and lowest five performing sires for Net Feed Intake - Feedlot

	Net Feed Intake - Feedlot
Cohort 1	1.24 kg/day
Cohort 2	1.70 kg/day
Cohort 3	1.58 kg/day
Average	1.51 kg/day



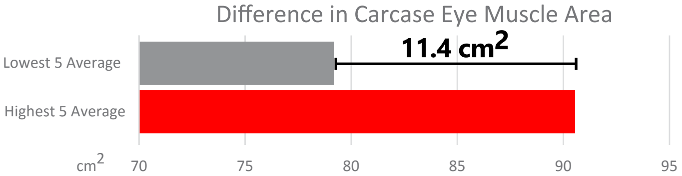
Carcase Composition (Carcase Weight, Eye Muscle Area, Intramuscular Fat, Rib Fat & Rump Fat)

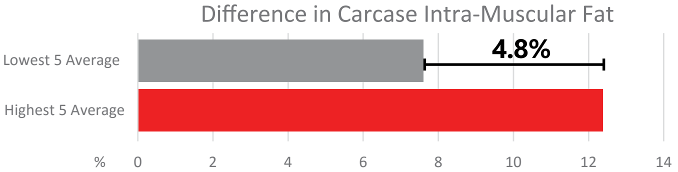
The progeny of the five sires with the heaviest carcase weight progeny at slaughter had a dressed carcase weight that was on average 50.5 kg heavier than the progeny of sires with the lightest carcase weights.

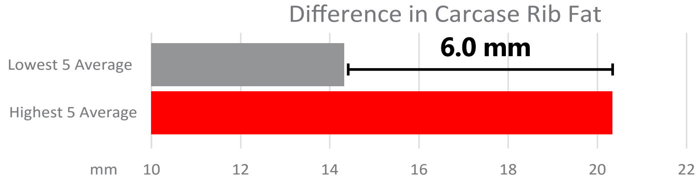


Similarly, the eye muscle area was on average 11.4 cm^2 larger, the intramuscular fat 4.8% higher, the rib fat 6.0 mm greater and the rump fat 7.1 mm greater when comparing the average progeny performance of the five highest and lowest performing sires for each of these traits in each respective cohort.

This demonstrates the significant potential to improve carcase composition through selection of Angus animals with superior genetics for these traits.







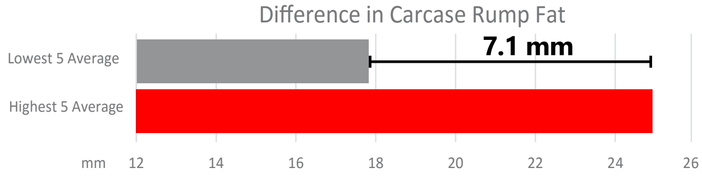


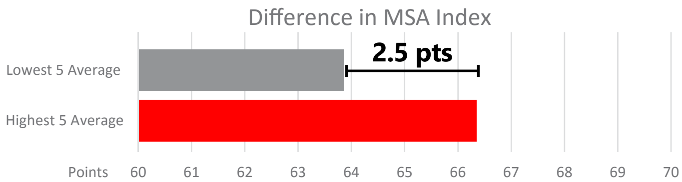
TABLE 4 : Difference between average progeny performance of highest five and lowest five performing sires for Carcase Composition Traits (Carcase Weight, Eye Muscle Area, Intramuscular Fat, Rib Fat, Rump Fat)

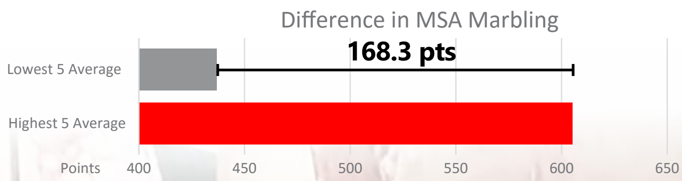
	Carcase Weight	Carcase EMA	Carcase IMF	Carcase Rib Fat	Carcase Rump Fat
Cohort 1	49.9 kg	9.1 cm^2	4.4 %	7.2 mm	6.9 mm
Cohort 2	46.5 kg	12.6 cm^2	5.3 %	5.0 mm	8.3 mm
Cohort 3	55.3 kg	12.4 cm^2	4.6 %	5.8 mm	6.2 mm
Average	50.5 kg	11.4 cm^2	4.8 %	6.0 mm	7.1 mm

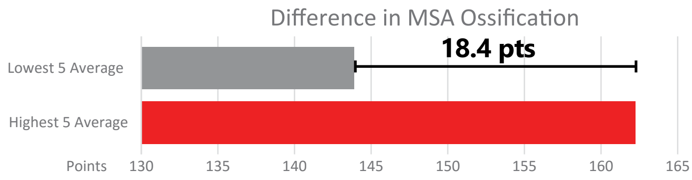
Carcase Quality (MSA Index, MSA Marbling, MSA Ossification Score, Shear Force)

When assessing MSA grading performance across cohorts 1, 2 and 3, the progeny of the five sires whose progeny achieved the highest MSA index scores ranked 2.5 points better than the average progeny performance of the five sires whose progeny had the lowest MSA index scores. Likewise, the average progeny performance for the five sires with the most marbling was on average 168.3 MSA marble score points higher than the five sires whose progeny had the least marbling, the average ossification 18.4 points lower for the progeny of the five sires with the least ossification, and the shear force 0.9 kg less for the progeny of the five sires with the highest meat tenderness.

This demonstrates the significant potential to improve carcase and subsequent eating quality through selection of Angus animals with superior genetics for these traits.







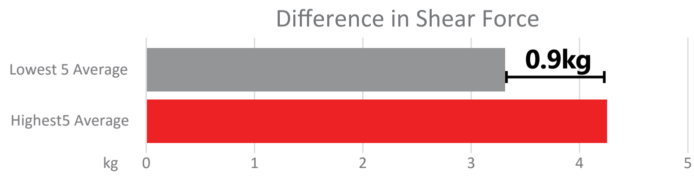


TABLE 5: Difference between average progeny performance of highest five and lowest five performing sires for Carcase Quality traits (MSA Index, MSA Marbling, MSA Ossification & Shear Force)

	MSA Index	MSA Marbling	MSA Ossification	Shear Force
Cohort 1	2.1	154.0	15.8	1.0
Cohort 2	3.1	194.0	23.1	0.9
Cohort 3	2.3	157.0	16.2	0.9
Average	**2.5**	**168.3**	**18.4**	**0.9**

SUMMARY

AVERAGE PERFORMANCE FOR PROGENY OF LOWEST 5 SIRES IN EACH COHORT

AVERAGE PERFORMANCE FOR PROGENY OF HIGHEST 5 SIRES IN EACH COHORT

		DIFFERENCE
CALVING EASE & FERTILITY	Birth Wt	4.9 KG
	Gestation Length	6.7 DAYS
	Days to Calving	37.1 DAYS
GROWTH	200 Day Wt	18.8 KG
	400 Day Wt	34.9 KG
	600 Day Wt	43.8 KG
NET FEED INTAKE (FEEDLOT)	NFI-F	1.5 KG/DAY
CARCASE COMPOSITION	Carcase Wt	50.5 KG
	Carcase EMA	11.4 CM^2
	Carcase IMF	4.8 %
	Caracase Rib Fat	6.0 MM
	Carcase Rump Fat	7.1 MM
CARCASE QUALITY	MSA Index	2.5 PTS
	MSA Marbling	168.3 PTS
	MSA Ossification	18.4 PTS
	Shear Force	0.9 KG

CONCLUSION

This project has revealed that there is a significant amount of genetic variation between animals within the Angus population and this variation presents a considerable opportunity to improve the productivity of Angus beef enterprises by utilising better genetics.

To capitalise on the genetic variation that exists, Angus producers should establish a clearly defined breeding objective and use animals in their breeding program that carry genetics which are aligned with this breeding objective.

Angus BREEDPLAN EBVs and selection indexes should be utilised to evaluate the genetics of each animal available for selection, while also considering other important selection criteria such as genetic condition status, breeding soundness, health status and the temperament of each animal.

For optimal results, it is important that selection decisions are not distracted by aesthetic features or the influence of non-genetic factors on the appearance and performance of animals.

Making considered selection decisions using all the information available on each animal offers the potential to best utilise the considerable genetic differences that exist between Angus animals and to maximise the genetic improvement that is achieved with an Angus beef breeding program.

References

http://www.mla.com.au/globalassets/mla-corporate/marketing-beef-and-lamb/documents/meat-standards-australia/tt_whole-set.pdf

FURTHER INFORMATION

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