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GeneNOTE 6

GeneSTAR Marbling® -

A key breeding and sorting tool for Japanese Black Wagyu producers



- **GeneSTAR® Marbling identifies animals that have 14-20% higher marble score.**
- **The GeneSTAR® Marbling test can improve the consistency of marbling score as well as increase the absolute levels of marbling in Japanese Black Wagyu and Wagyu cross animals.**
- **There are significant benefits of the test for sorting feeder cattle based on GeneSTAR® Marbling results.**
- **2-STAR animals had double the percentage of premium grade carcasses compared to 0-STAR.**

Introduction

The Japanese Black Wagyu breed is the undisputed breed leader for beef marbling (intra-muscular fat) and carcass quality with high premiums paid for the highest grades of marbling.

The breed also has unique lipid (fat) characteristics that are sought after by beef connoisseurs worldwide.

Black Wagyu breeders have been quick to adopt the GeneSTAR® Marbling test in their efforts to rank sires and achieve premium grades and prices.

It is a difficult and lengthy process to get accurate and timely genetic information due to:

- Marbling performance not being known until slaughter
- Progeny testing is less effective due to long periods of feeding required to achieve high marbling grades.
- Contemporary group allocation is complicated by the selection of animals for slaughter on different dates.

Results of recent trials conducted by Genetic Solutions and collaborators are the first to quantify the effects of GeneSTAR Marbling in Fullblood Wagyu cattle.

Definitions

Fullblood: Registered Wagyu proven by DNA parent verification to be fully descended from Japanese-registered Black Wagyu.

F1: First cross progeny of Purebred Wagyu sires.

F2: F1 cross back to a Purebred Wagyu sire.

BMS: Beef Marbling Score – Levels of marbling score used in the Japanese meat grading system (12 levels).

TRIAL 1: F1 AND F2 WAGYU-CROSS STEERS AND HEIFERS

This study was conducted in cooperation with a commercial breeder and finisher of Wagyu cross cattle.




More than 20 bulls sired the 230 steers and heifers used in the trial. They were mainly F1 cattle, the result of matings between Fullblood Wagyu and Angus with some F2 backcrosses to Fullblood Wagyu bulls.

The co-operator supplied meat samples and carcass data. The cattle had been on feed in the feed yard for 300 – 350 days. Their carcass weights varied from 932lbs to 1228lbs.

Frequency

The frequency of GeneSTAR Marbling results for Trial 1 cattle is shown in Table 1 together with the frequencies from more than 1000 tests conducted by Genetic Solutions on Fullblood and Purebred Japanese Black Wagyu.

Table 1: Frequencies of GeneSTAR® Marbling results in Trial 1 animals and in Japanese Black Wagyu Fullblood and Purebred seedstock.

			
Trial 1 (F1 + F2)	41%	45%	14%
Fullblood Wagyu	10%	51%	39%

The frequency of 1 and 2-STAR animals in the F1 and F2 animals in Table 1 is lower than would be expected from Fullblood or purebred animals.

Results

Level of marbling was assessed by company graders using the BMS of the Japan Meat Grading Association. It uses a 1-12 scale where 1 is almost devoid of marbling and 12 is extremely marbled.

Table 2: Average Beef Marbling Score (BMS) for each GeneSTAR® Marbling result in Trial 1

			
BMS	4.2	4.6	5.1

Marbling scores for the 0-STAR, 1-STAR and 2-STAR steers and heifers are shown in Table 2. The effect of GeneSTAR results on marbling score was statistically significant ($P < 0.05$) with 2-STARs having 0.9 points higher marbling score (+20%) than 0-STARs, with the 1-STAR animals intermediate.

Correlated Effects

Consistent with all previous trials with this marbling gene there was no significant effect on other carcass traits measured which included carcass weight, rib fat, eye muscle area and meat colour.

TRIAL 2: F1 AND F2 WAGYU-CROSS STEERS

172 F1 and F2 steers and heifers were fed concentrate rations in a feed yard for an average of 527 days. They were the progeny of 35 Fullblood Wagyu sires and at slaughter averaged 979lbs.

Results

Table 3: Average Beef Marbling Score (BMS) for each GeneSTAR® Marbling result in Trial 2

			
BMS	6.1	6.9	6.9

Marbling results show that the 2-STAR carcasses were on average 0.8 BMS higher (+14%) than 0-STAR animals. In this trial the 1-STAR effect was the same as the 2-STAR effect, showing that most of the effect on marbling was achieved with only one copy of the high marbling form of the gene. The GeneSTAR Marbling effects were similar in both F1 and F2 animals.

There was no effect of GeneSTAR Marbling on other carcass traits such as carcass weight, rib fat and dressing per cent.

Distribution of Marbling and STAR Genotypes

Figure 1 shows a number of important effects of GeneSTAR Marbling on the distribution of Beef Marbling Score within the group of animals in Trial 2.

No 0-STAR animals were represented in the two highest marbling scores measured (BMS = 10 or 11). Forty five per cent (45%) of 2-STAR animals had BMS greater than 8 compared to sixteen (16 %) of 0-STARs.

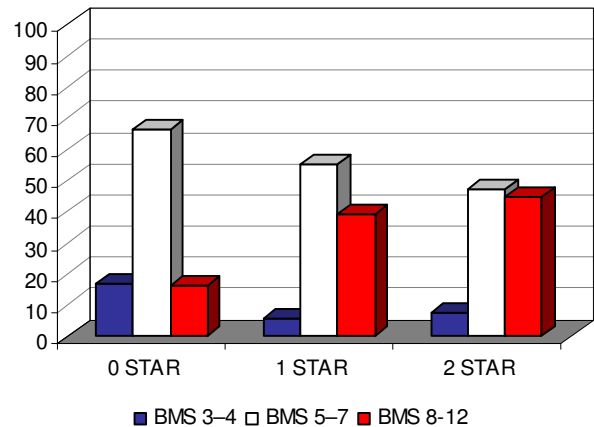


Figure 1: Distribution of Beef Marbling Score (BMS) for 0, 1 and 2-STAR genotypes

Seven per cent (7%) of 2-STARs and 17% of 0-STARs had **low** marbling scores i.e. lower than a BMS of 4.

Given the strong relationship between BMS and price/kg paid for a Wagyu or Wagyu-cross carcasses, these differences are extremely valuable.

TRIAL 3: FULLBLOOD WAGYU STEERS


This trial was conducted on 163 Fullblood Japanese Black Wagyu steers and heifers. These were the progeny of a 1 STAR bull, and represented high, medium and low marbling scores.

The steers and heifers were fed to an average carcass weight of 903lbs under typical Japanese feeding systems. BMS was measured on a 1–12 scale as described for Trials 1 and 2

Results

Results for genotype frequency and average marbling scores are shown in Table 4.

Table 4: GeneSTAR® Marbling frequency (%) and average Beef Marbling Score (BMS) for each GeneSTAR® Marbling result in Trial 3.

			
Frequency (%)	11	42	47
BMS	6.0	7.0	7.2

The frequency of 1 and 2 STAR animals was high as would be expected from Fullblood Wagyu steers.

A significant advantage of 1.2 BMS (+20%) was recorded for 2-STAR compared to 0-STAR animals, showing that most of the effect on marbling was achieved with one copy (1-STAR) of the high marbling form of the gene. There were no significant GeneSTAR effects on other carcass traits.

Applications of GeneSTAR® Marbling for Wagyu producers

1. At the breeding level

Since the frequency of the 2-STAR high marbling genotype is at around 40% in Fullblood Japanese Black Wagyu, the results from these trials shows there is scope to use the GeneSTAR Marbling test to improve the consistency of marbling in the breed and its crosses as well as the absolute levels of marbling in the breed. DNA marker-assisted selection can be applied for both sires and dams.

The key to increasing the percentage of 1 or 2-STAR feeder steers or heifers in a Wagyu seedstock herd is to use 2-STAR sires or semen from 2-Star sires. The effect is dramatic as can be seen in Figure 2 because a 2-STAR sire always passes on 1-STAR to its progeny. A 2-STAR sire mated to a 2-STAR female will always produce a 2-STAR calf.

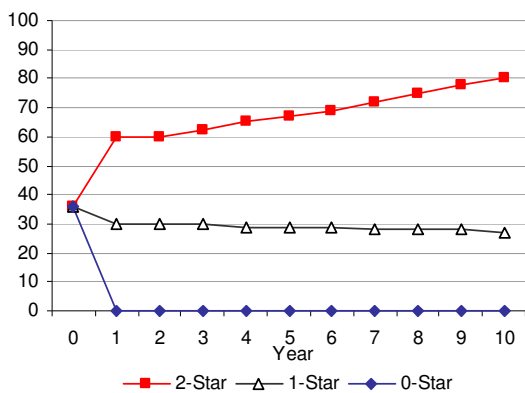


Figure 2. Change in proportion of 2-star calves from using 0, 1 or 2-star bulls.

2. Sorting at the commercial level prior to feeding using GeneSTAR® Marbling

Pre-screening of steers and slaughter heifers prior to 'long feeding' can identify 1 or 2-STAR animals with high marbling potential. As the Wagyu content of the feeders increases and the days on feed lengthens, so does the economics of using GeneSTAR Marbling, due to the higher premiums achievable or greater penalties for carcasses that fail to meet contract specifications for marbling.

Most importantly, the 0-STAR animal of lower marbling potential can be removed or diverted into shorter feeding programs where the cost of not meeting the higher marbling specifications is lower, or there is no marbling score requirement. Any tool that lowers the risk of feeding an animal full-term, only to find that it does not marble, is very valuable.

If feeder steers are accurately sire-identified and the sires are a 2-STAR then you know that all the progeny will be at least 1-STAR or, if out of 1 or 2-Star cows could be 2-STAR. However if 0 or 1 STAR

sires have been used, and there is any question about the quality of the sire information or the genetics of a particular mob of purchased cattle is unknown, then the GeneSTAR Marbling test on the steers or heifers is recommended.

Commercial Summary

The observed increase in average BMS as well as the dramatic increase in the percentage of high premium marbling carcasses will provide significant returns to feeders of Wagyu cattle who use the GeneSTAR Marbling test. In addition the ability to sort animals that have a high probability to produce low marbling scores will provide significant cost savings.

Conclusions

The GeneSTAR Marbling effect has been remarkably consistent in five previous evaluation trials in Australia and United States of America with various breed types and different feeding systems.

These three new trials extend the consistency of the effect into long-fed Wagyu-crosses as well as fullblood steers

The effects detected in these trials are larger than previously recorded in shorter fed cattle. Because of the higher \$ premiums for marbling grade of beef sold in Japan, the returns from using GeneSTAR marbling are even more valuable

Marbling and Beef Carcass Grading Standards in Japan

Meat grading at meat wholesale markets and meat centres in Japan is controlled by the Japan Meat Grading Association which grades 75% of beef and pork carcasses in the country.

Grading of carcasses plays an important role in the establishment of supportive prices for production and for the rationalisation of distribution channels.

Meat quality score is measured in terms of beef marbling, meat colour, brightness, firmness and texture of meat, colour, lustre and quality of fat.

In the Japanese grading system there are twelve standards of BMS. These BMS are then grouped to represent five quality grades.

Particularly in the Japanese beef market beef marbling grade is rewarded with significant premiums commensurate with BMS score.



Frequently Asked Questions

Q: *Is there only one gene that affects marbling?*

A: No there are more but only a small number are likely to have a large effect. Further R&D is being carried out to develop tests for other genes.

Q: *Does the effect of this test show up in the IMF% EBV?*

A: An IMF% EBV reflects all the marbling genes that an animal has. In time the GeneSTAR Marbling result may be incorporated in IMF% EBVs.

Q: *What is the best way to speed up marbling trait improvement with this test?*

A: Using 2-STAR bulls with high IMF% EBV or Marbling EPD and mating them to cows with 1 or 2-STAR results that also have high IMF% EBVs. This strategy will also increase the frequency of two star animals.

Q: *What gene does GeneSTAR® marbling test show?*

A: It shows a form of the thyroglobulin gene that has been associated with higher marbling by CSIRO in trials of 200-day fed cattle. This form of the gene is given a star in the GeneSTAR rating system and animals have either zero, one or two stars.

Q: *Will every bull 'known' for high marbling have one or two stars?*

A: Not necessarily. There is more than one gene that has a large effect on marbling. An animal with high 'known' marbling may have achieved this through a unique combination of the other marbling genes.

Q: *Do animals with one or two stars exist in all breeds?*

A: Testing of a large number of breeds has shown 2-STAR animals in most breeds, with higher frequencies of 2-STAR animals in known marbling breeds such as Japanese Black Wagyu, Angus (Black and Red) and Shorthorn.

Q: *Are there GeneSTAR® tests for any other traits?*

A: Yes, there is currently a test available for Tenderness which tests for the presence of the Calpastatin gene. Calpastatin is a naturally occurring enzyme that inhibits the normal tenderising of meat as it ages post-mortem. Genetic Solutions aims to commercialize additional gene tests for production traits in the future.

Q: *Does GeneSTAR® Marbling or Tenderness have an impact on any other production traits?*

A: All trials have shown that there are no significant effects of GeneSTAR Marbling or Tenderness on any other carcass traits measured.

Mating Designs

The result of mating different GeneSTAR bulls with various GeneSTAR cows is shown in terms of expected progeny proportions below.

Sire is	Dam is	Proportion of progeny expected to be		
		0	★	★★
0	0	100%	50%	100%
0	★	50%	50%	25%
0	★★	25%	50%	50%
★	0	50%	50%	25%
★	★	100%	50%	50%
★	★★	50%	50%	100%

Genetic Solutions

Office: 31 Dover St, Albion QLD 4010

Phone: 1300 768 400

Fax: 1300 768 555

Email: enquiries@genestar.com.au

Web: www.genestar.com.au