Case Study: Extension efforts around the use of DNA tests for the U.S. beef cattle industry

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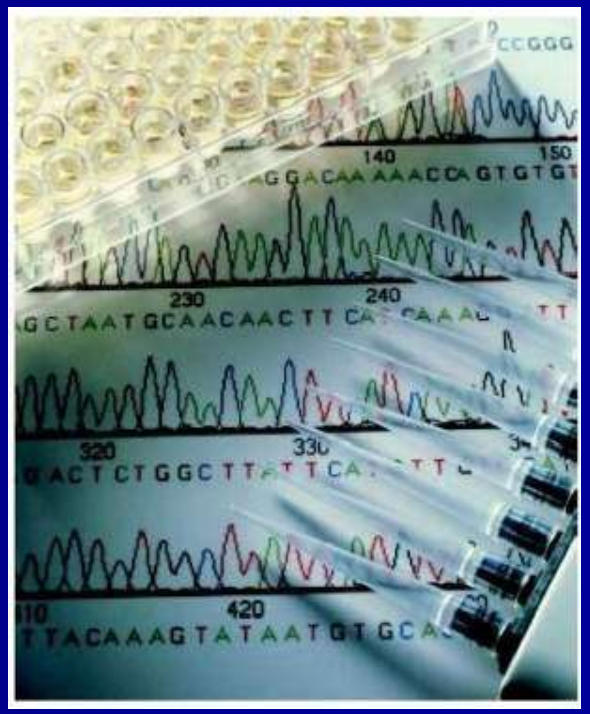


animalscience.ucdavis.edu/animalbiotech

There are various companies offering DNA tests for marker-assisted selection/management in beef cattle

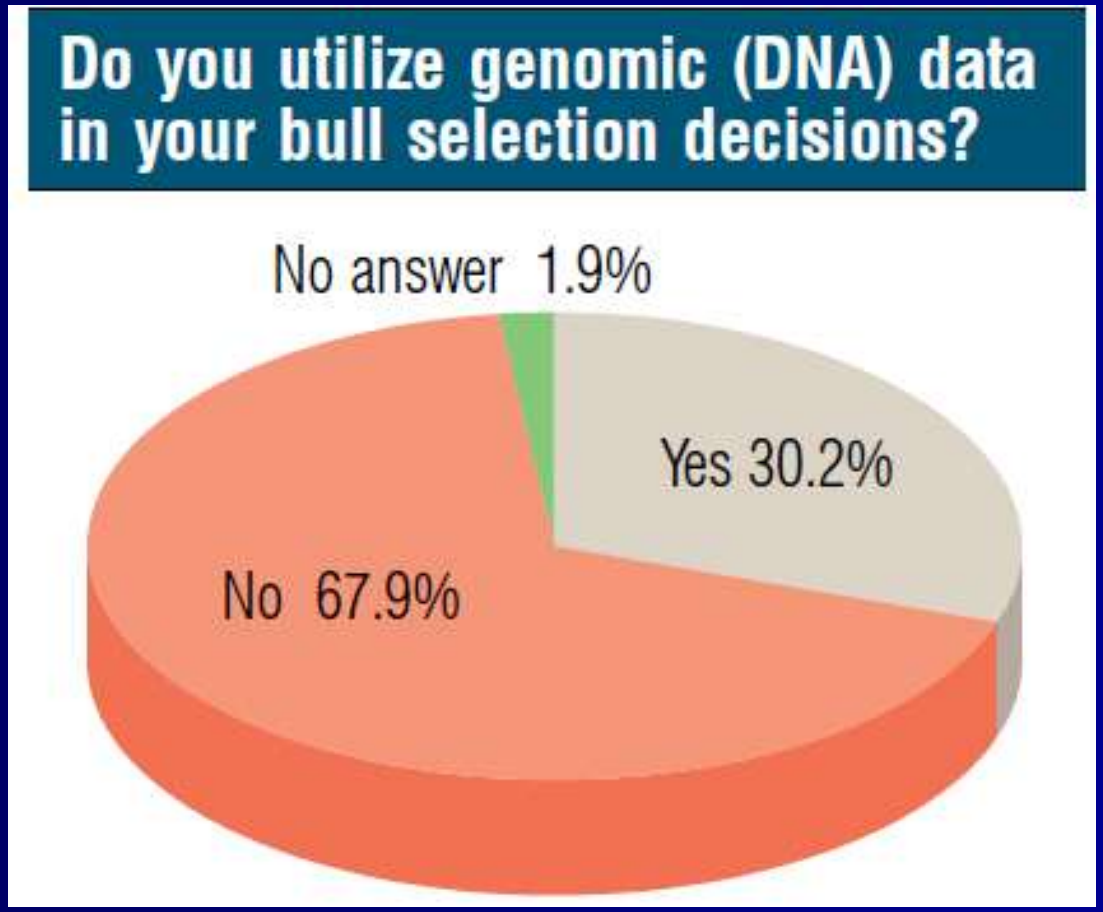
"[DNA tools] are a cool insight and eventually we'll use it, but we really don't know how to use it."

—Ben Spitzer

http://beefmagazine.com/genetics/beef-data-overload-20100301/

March 1, 2010 Beef Magazine Survey

http://beefmagazine.com/genetics/beef-asked-answered-20100301



Base = 635 (All Cow-Calf Operations)

Merial, Quantum sign leptin test pact.(Business Report)

Publication: Feedstuffs

Publication Date: 04-AUG-03

SASKATOON, SASK., and DULUTH, GA. -- Quantum Genetics Inc. and Merial Ltd. announced July 23 that they have entered into a global marketing agreement to provide Merial with exclusive rights to market Quantum's new patent-pending DNA test to determine an animal's leptin genotype.

The leptin protein has been demonstrated...

Advanced technology. Advanced knowledge.

What if there was a test that could tell you – in advance – an animal's genetic potential for energy utilization or carcass quality? You'd have the advantage of knowing an animal's potential now, instead of discovering it later through success or failure in the milk string or when the animal goes to market.

Researchers have discovered the specific gene that carries the code for the production of a protein called *leptin*. Leptin is associated with an animal's potential for appetite and energy utilization, among other things.

- For *dairy cattle* this translates directly into maximum dry matter intake (DMI) and peak milk production.
- For *beef cattle* it relates to days on feed and carcass quality.

The IGENITY™ L Test identifies leptin genotype (L-tt™, L-ct™ or L-cc™). Now you have another important resource to help you breed, feed, sort, manage and market cattle at an optimum level.

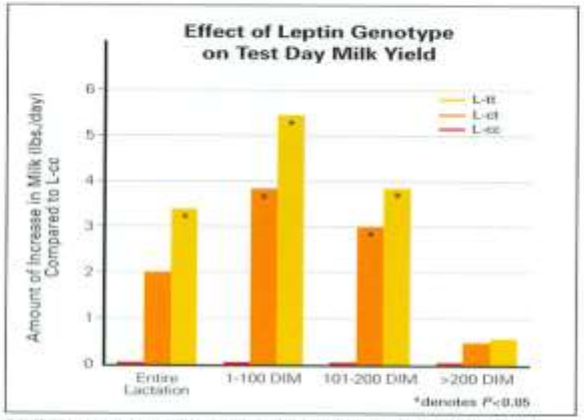
For the dairy producer.

The science behind IGENITY L lets you identify genetic ability for:

- increased dry matter intake (DMI)
- greater peak and overall lactation yield with increased protein solids
- improved body condition scores
- superior energy utilization
- quicker return to positive energy balance.

In trials, L-tt cows outperform L-cc cows:[1]

- entire lactation – 3.3 lbs more milk/day
- first 100 days – 5.38 lbs more milk/day.



SOURCE: Buchanan, et al. 2003. An Association Between a Leptin Single Nucleotide Polymorphism and Milk and Protein Yield. *Journal of Dairy Science* 86:3164-3166.

Use IGENITY L to:

- Select bulls to improve the leptin profile of your herd.
- Select cows and replacement heifers with the greatest potential.
- Sort and feed for optimum early lactation performance.

For the beef producer.

The IGENITY L Test helps you identify genetic potential for:

- greater DMI
- superior marbling ability
- more efficient energy utilization.

In trials through to slaughter:

- Cattle with higher leptin concentrations had higher marbling scores.[2]
- Cattle with L-tt leptin were up to 5 times more likely to grade Choice than cattle identified as L-cc.[3]

Effect of Genotype on Carcass Quality

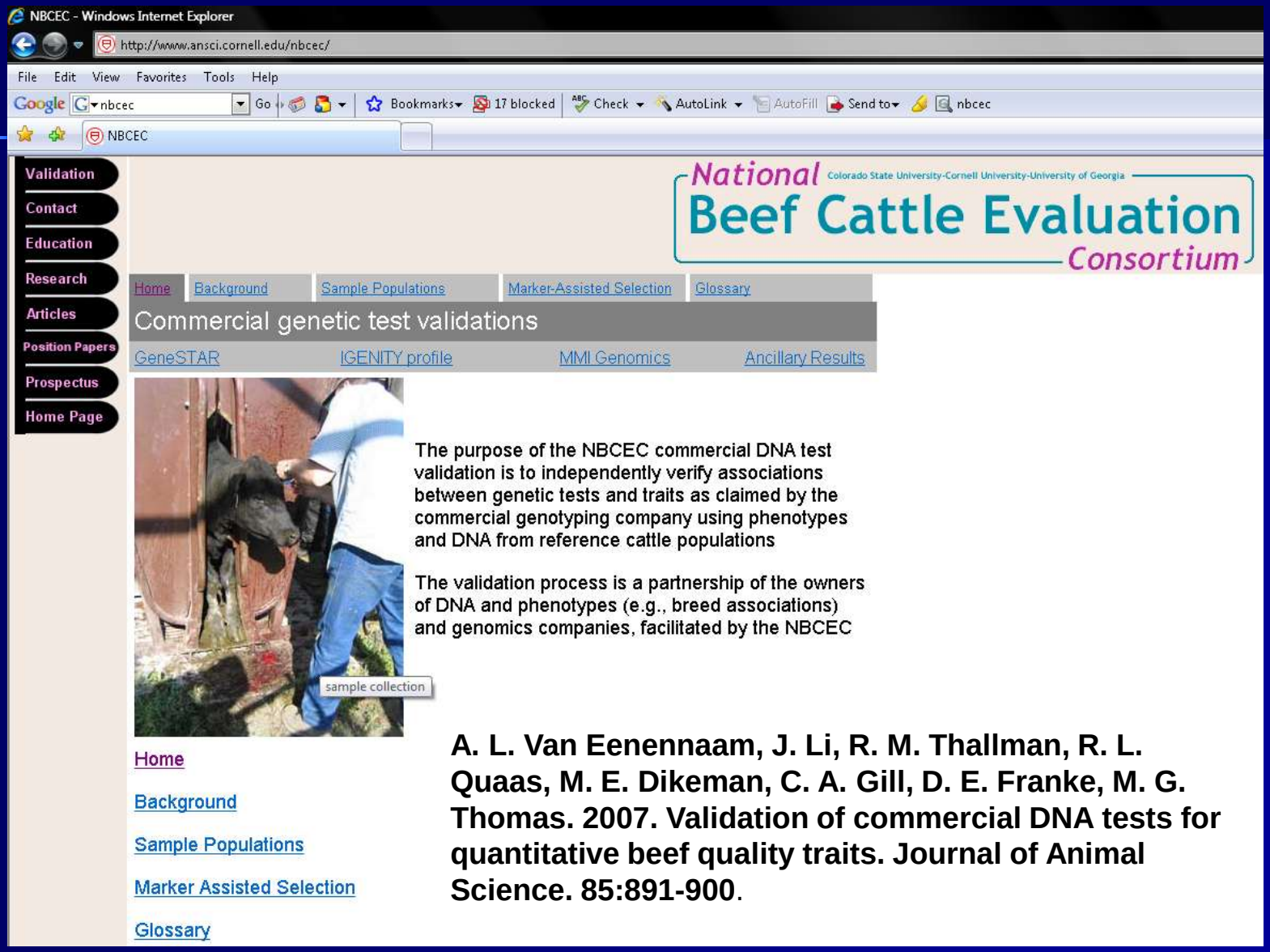
	L-cc	L-ct	L-tt	*P*-value
Trial 1 - % Choice	11	29	62	0.03
Trial 2 - % Choice	0	19	48	0.01
Trial 3 - % Choice	38	45	58	0.07

Trial 1: AzTx Feeders (Charolais/Angus steers), Trial 2: Doerksen Feedlot (Hereford steers), Trial 3: University of Saskatchewan (Charolais steers)
SOURCE: Quantum Genetics, Inc.

IGENITY L can help you:

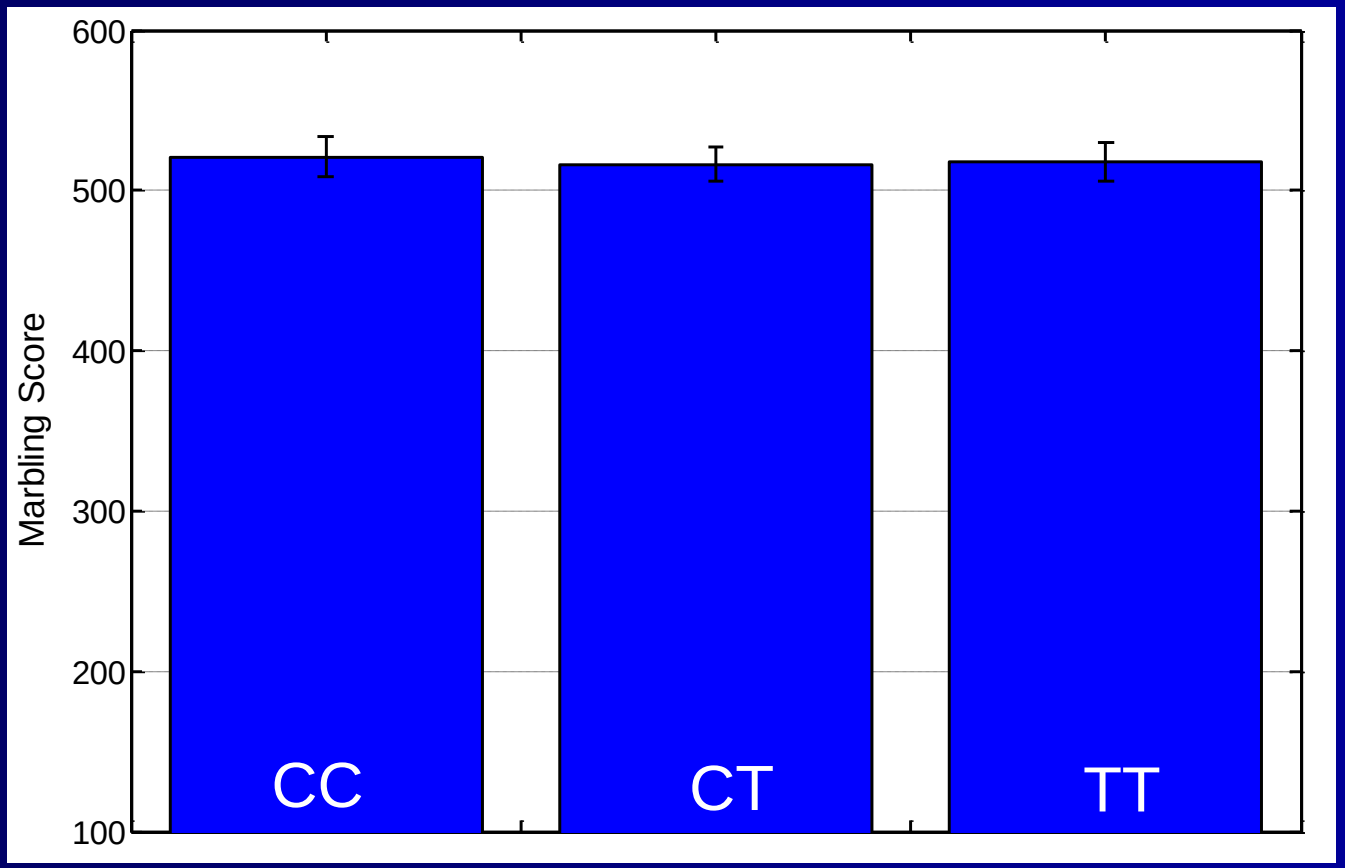
- Buy L-tt bulls to improve your herd's potential for marbling.
- Retain cows and select replacement heifers with desired leptin genotype, along with other genetic traits.
- Breed, feed and sort cattle so they reach targeted endpoints uniformly and efficiently.

Independent validation of DNA tests http://www.nbcec.org/nbcec/



A. L. Van Eenennaam, J. Li, R. M. Thallman, R. L. Quaas, M. E. Dikeman, C. A. Gill, D. E. Franke, M. G. Thomas. 2007. Validation of commercial DNA tests for quantitative beef quality traits. Journal of Animal Science. 85:891-900.

Leptin Genotype Effects on Marbling Score (NBCEC Data)



Data provided by R. L Quass, Cornell

IGENITY profile results and associated effects*

IGENITY Result	Residual Feed Intake (Indicus)**	Residual Feed Intake (Taurus)**	Average Daily Gain***	Tenderness in lbs. of WBSF	USDA Marbling Score	% Choice & higher	Yield Grade	Back Fat Thickness (in)	Ribeye Area (in^2)	Heifer Pregnancy Rate (%)	Stayability (%)	Maternal Calving Ease (%)	Docility (%)
10	5.5	4.2	0.81	-2.3	161.4	64.4	1.35	.37	2.56	18.8	16.7	9.5	45.4
9	5.0	3.6	0.72	-2.0	141.3	57.2	1.21	.32	2.22	16.2	14.7	8.4	39.6
8	4.2	3.1	0.64	-1.9	123.6	50.1	1.07	.28	1.93	14.2	12.9	7.3	34.7
7	3.6	2.7	0.54	-1.5	106.4	42.9	0.92	.24	1.64	12.1	11.2	6.2	30.0
6	3.0	2.2	0.44	-1.2	88.4	35.8	0.76	.21	1.35	10.0	9.5	5.1	25.3
5	2.4	1.8	0.34	-1.1	70.6	28.6	0.61	.17	1.07	8.1	7.6	4.1	20.5
4	1.9	1.3	0.24	-0.8	53.3	21.5	0.46	.13	0.80	6.0	5.8	3.1	15.7
3	1.2	0.9	0.14	-0.4	35.5	14.3	0.31	.09	0.53	4.0	3.9	2.0	10.7
2	0.6	0.4	0.05	-0.2	17.7	7.2	0.15	.06	0.24	1.9	2.5	1.0	5.8
1	0	0	0	0	0	0	0	0	0	0	0	0	0
P-value	5.7E-13	8.04E-08	2.4E-19	1.9E-08	3.8E-18	1.0E-20	1.6E-16	3.9E-20	1.8E-14	2.6E-30	1.1E-34	4.2E-32	3.1E-19

*Data on file at Merial. Results expressed represent differences expected in animals compared to contemporaries with IGENITY Profile scores of 1.
**Lbs of feed per day.
*** Lbs of gain per day.
WBSF = Warner-Bratzler shear force

igenity®

MERIAL

http://us.igenity.com/pdfs/forms/Igenity%20Results%20Key%20Beef.pdf

Commercial genetic test validations

Summary of NBCEC validations for commercially-available DNA-tests for complex (quantitative or multigenic) traits in beef cattle (note: validations do not include tests for "simple" traits such as coat color, horned/polled, AM status etc.)

Company	Test Name	Trait	Date of validation
Igenity www.igenity.com	Profile®	Fat Thickness	12/2008
	Profile®	Marbling Score	12/2008
	Profile®	Quality Grade (% ≥ Choice)	12/2008
	Profile®	Rib Eye Area	12/2008
	Profile®	Yield Grade	12/2008
	Profile®	Average Daily Gain	12/2008
	Profile®	Tenderness	12/2007
	Profile®	Residual Feed Intake (RFI) (for *Bos indicus* influenced cattle)	12/2007
	Profile®	Residual Feed Intake (RFI) (for *Bos taurus* cattle)	6/2008
	Profile®	Dry matter intake (DMI) (for *Bos indicus* influenced cattle)	12/2007
	Profile®	Heifer Pregnancy Rate	
	Profile®	Stayability (longevity)	
	Profile®	Maternal Calving Ease	
	Profile®	Docility	
Pfizer Animal Genetics (Bovigen) www.bovigen.com	GeneSTAR® Tenderness MVP	Tenderness	2/2009
	GeneSTAR® Marbling MVP	% IMF (Feedlot cattle)	2/2009
	GeneSTAR® Feed Efficiency MVP	Net Feed Intake (NFI)	2/2009
MMI genomics www.metamorphixinc.com	Tru-Marbling™	Marbling Score and Quality Grade	
	Tru-Tenderness™	Tenderness	

IGENITY profile Feed Efficiency for Bos taurus cattle SUMMARY

The IGENITY TAURUS feed efficiency MBVs were inconsistently associated with residual feed intake in the validation populations. In two populations there was a significant positive association of the MBV with the trait (North American Bos Taurus, CRC Temperate), but in the remaining four populations there was no significant effect and in both Angus populations the estimated association was negative, meaning that the results were associated in the opposite direction.

For further information on this validation contact Dr. John Pollak (607) 255-2846.

TEST DATASET	Trait	PANEL	b	P	N
TEMPERATE[1] (CRC1)	RFI	TAURUS	0.309	0.04	~546
SHORTHORN[1] (CRC)	RFI	TAURUS	0.393	0.17	~189
ANGUS (CRC)[1]	RFI	TAURUS	-0.426	0.95	~327
NORTH AMERICAN BOS TAURUS[2]	RFI	TAURUS	0.351	0.005	~706
NORTH AMERICAN CHAROLAIS[3]	RFI	TAURUS	0.022	.443	~393
NORTH AMERICAN ANGUS[3]	RFI	TAURUS	-0.217	0.89	~436

[1] Data analyses for these validation populations were performed by Dr. David Johnston, Animal Genetics and Breeding Unit, University of New England, Armidale, Australia (6/2008).

[2] Data analyses for this validation population was performed by Gordon VanderVoort, Dr. Matt Kelly, Duc Lu and Dr. Stephen Miller, University of Guelph (6/2008)

[3] Data analyses for these validation populations were performed by Dr. Denny Crews, Agriculture and Agri-Food Canada (6/2008)

IGENITY® Price Guide

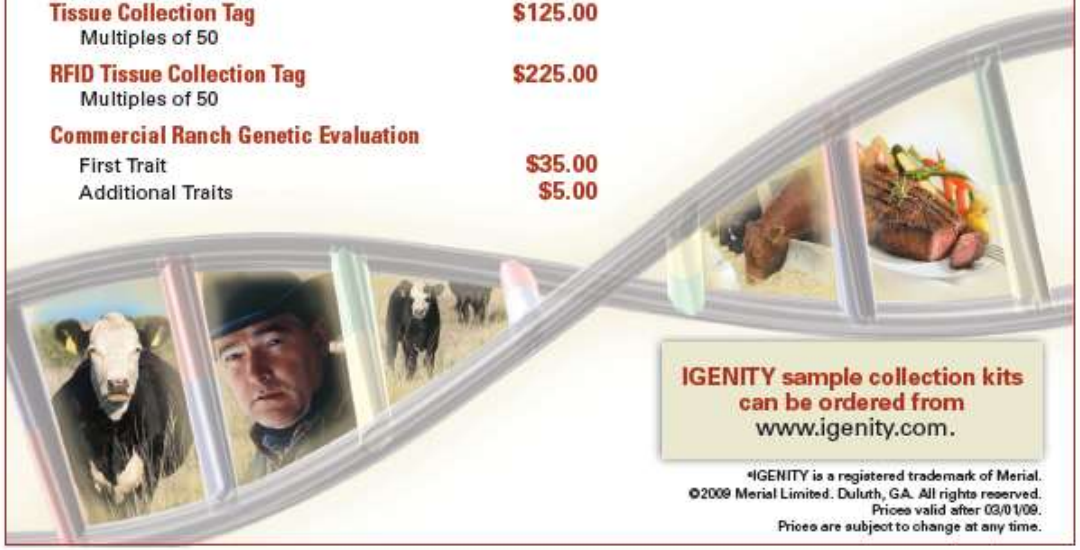
for beef

USD$

IGENITY® Profile	**$38.00**
Carcass Composition	
Tenderness, % Choice/Quality Grade, Yield Grade, Ribeye Area, Fat Thickness, Marbling.	
Maternal Traits	
Heifer Pregnancy Weight, Calving Ease, Stayability	
Docility	
Average Daily Gain	
Add BVD PI to the IGENITY Profile	**$3.00**
Available for tissue collectors only	
Add Coat Color to the IGENITY Profile	**$5.00**
Add Multi-Sire Parentage to the IGENITY Profile	**$10.00**
Add Myostatin to the IGENITY Profile	**$15.00**
Add Arthrogryposis Multiplex to the IGENITY Profile	**$26.00**
Add Feed Efficiency to IGENITY Profile	**$20.00**
Available for Bos indicus and Bos taurus.	
Add Horned/Polled to IGENITY Profile	**$50.00**
See the IGENITY Order Form for breed specifications.	
IGENITY Multi-Sire Parentage *without* the IGENITY Profile	**$25.00**
IGENITY Arthrogryposis Multiplex *without* the IGENITY Profile	**$26.00**
Tissue Collection Tag Multiples of 50	**$125.00**
RFID Tissue Collection Tag Multiples of 50	**$225.00**
Commercial Ranch Genetic Evaluation	
First Trait	**$35.00**
Additional Traits	**$5.00**

The IGENITY profile.

Inside information to help you achieve goals faster.



IGENITY sample collection kits can be ordered from www.igenity.com.

Angus Genetics Inc.® and IGENITY® to Introduce Industry's First Genomic-enhanced EPDs for Multiple Traits

Angus producers will have first access to breed-specific DNA profile

DULUTH, Ga. - July 14, 2009 - Angus Genetics Inc.® (AGI) and Merial have entered into an exclusive agreement to provide American Angus Association® breeders with genomic-enhanced expected progeny differences (EPDs) powered by IGENITY®. This will be the first time beef producers have access to genomic-enhanced EPDs for multiple traits at once - and from an Angus-specific DNA profile.

Bill Bowman, president, AGI, says this agreement joins two groups committed to advancing genetic improvement in the beef industry.

"AGI and IGENITY share a common vision to provide beef producers with the most advanced solutions to their genetic selection and management needs," Bowman says. "This represents a significant milestone for our industry - one our board has directed us to pursue aggressively for the past two years and supported with collaboration and research dollars."

The combination of a breed-specific DNA profile with the Angus National Cattle Evaluation (NCE) will result in higher-accuracy EPDs. This will be an especially powerful tool for evaluating young animals, as cattle will now have accuracies that were previously only possible once they had multiple progeny on the ground, Bowman says.

Dr. Stewart Bauck, executive director of research and development, IGENITY, commends AGI and its parent company, the American Angus Association, for leading this charge.

"The American Angus Association has set the standard in data collection and embracing cutting-edge technologies," he says. "We appreciate the work the Association has done to keep the breed at the forefront of the beef industry by helping bring this advancement to Angus breeders."

Bowman says the selection of a DNA technology partner was a logical decision.

"IGENITY has a robust profile of analyses, including the industry's only DNA analyses for reproduction and maternal traits in combination with all of the economically important carcass traits," he says. "Plus, the addition of the genomic tools from IGENITY into our NCE system provides us the ability to improve the accuracy of Angus EPDs - especially in young animals."

Dr. Bauck adds that genomic-enhanced EPDs for multiple traits have become a reality after years of collaboration among beef industry leaders.

"The industry agreed that genomic-enhanced EPDs were the next advancement in DNA technology," he says. "It was our responsibility as the leading DNA technology provider to take action and move the topic of genomic-enhanced EPDs from an industry discussion to a user-friendly solution."

The Power of the IGENITY® profile for Angus

The American Angus Association® through its subsidiary, Angus Genetics Inc.® (AGI), has a vision to provide Angus breeders with the most advanced solutions to their genetic selection and management needs.

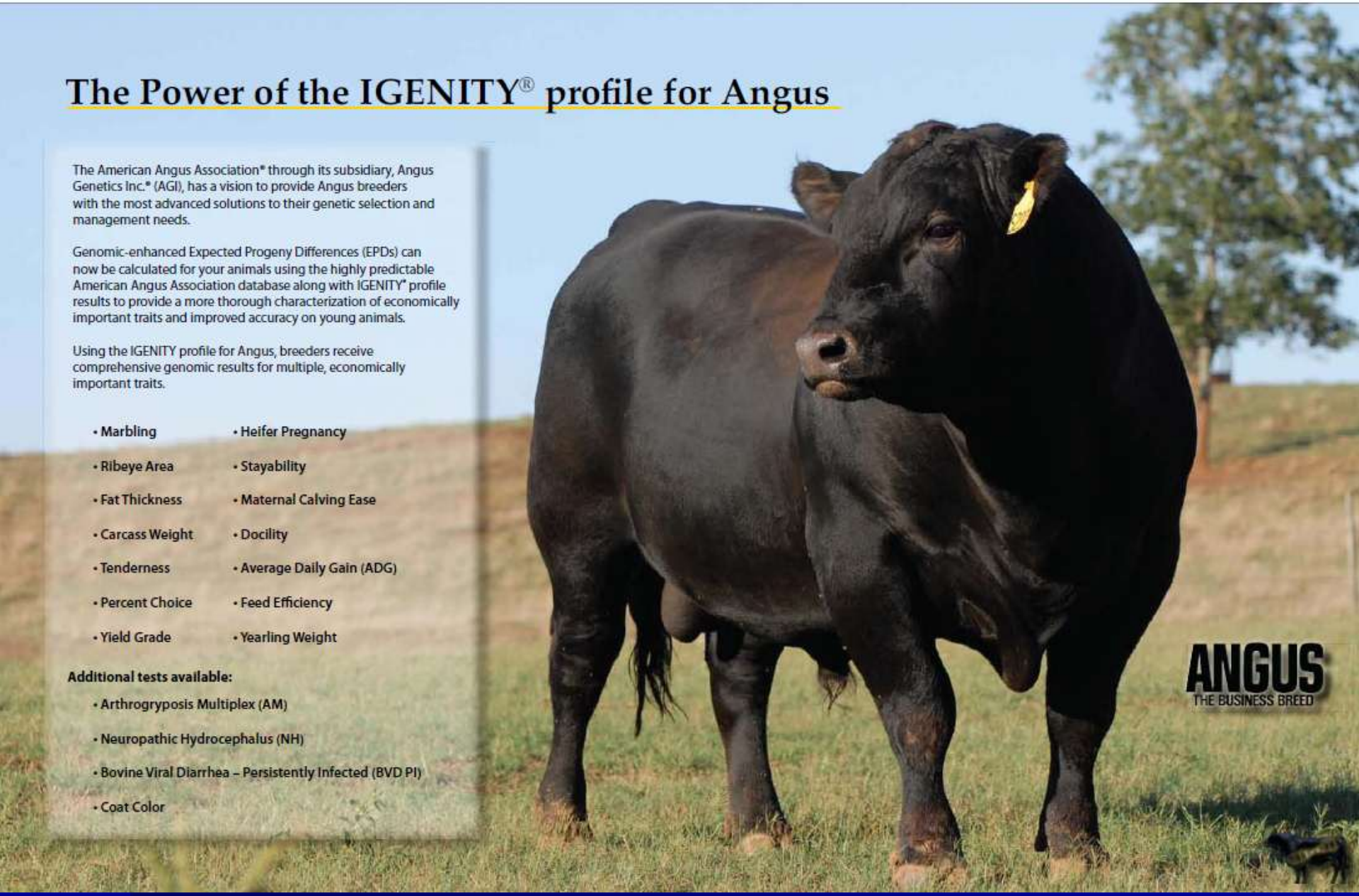
Genomic-enhanced Expected Progeny Differences (EPDs) can now be calculated for your animals using the highly predictable American Angus Association database along with IGENITY® profile results to provide a more thorough characterization of economically important traits and improved accuracy on young animals.

Using the IGENITY profile for Angus, breeders receive comprehensive genomic results for multiple, economically important traits.

- Marbling
- Ribeye Area
- Fat Thickness
- Carcass Weight
- Tenderness
- Percent Choice
- Yield Grade
- Heifer Pregnancy
- Stayability
- Maternal Calving Ease
- Docility
- Average Daily Gain (ADG)
- Feed Efficiency
- Yearling Weight

Additional tests available:

- Arthrogryposis Multiplex (AM)
- Neuropathic Hydrocephalus (NH)
- Bovine Viral Diarrhea – Persistently Infected (BVD PI)
- Coat Color



igenity®

HOW TO USE GENOMIC-ENHANCED EPDS FOR ANGUS

Genomic-enhanced EPDs are to be used in the exact same way other EPDs are used, as a comparison between animals. These EPDs include all available records, including ultrasound, carcass, and genomic profile results. As data is added to an animal's record, the EPD is expected to change to reflect the animal's true genetic merit. Accuracy values associated with the EPD are the best indicator of the possible amount of change expected in the EPD and will increase as more information is added.

Carcass EPDs and Accuracy					
CW Acc	Marb Acc	RE Acc	Fat Acc	Carc Grp Acc	Usnd Grp Usnd Pg
+19 .13	+.64 .19	+.48 .24	-.011 .21		

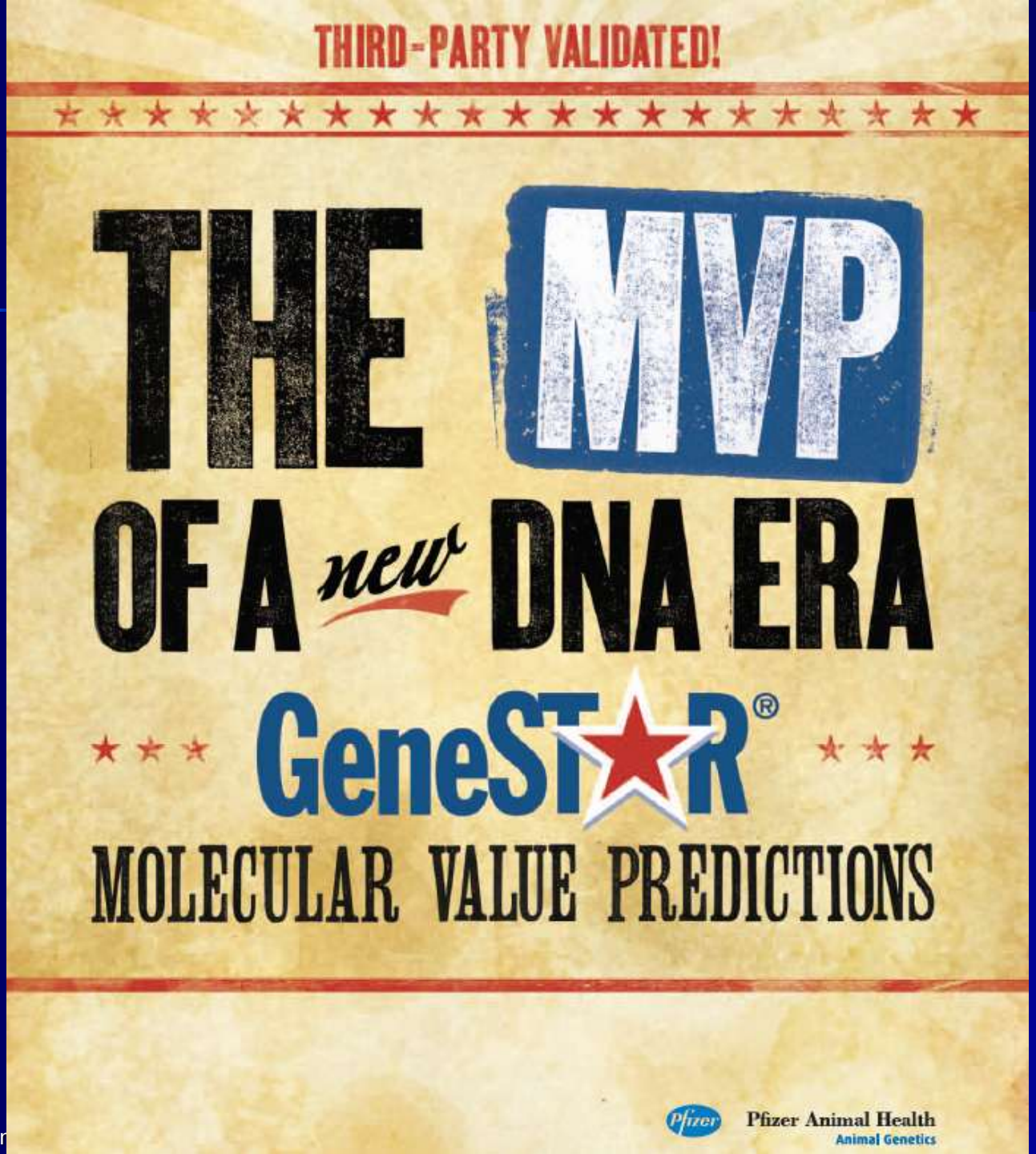
DNA PROFILE SCORES

EPDs may not be currently available for all traits. Genomic results on animals are accompanied by categorical rankings, or Profile Scores. The profile scores from the IGENITY profile for Angus are reported on a scale from 1 to 10 to assist producers in understanding the relative value of an animal's genetic potential based on DNA analysis. Profile scores do not predict actual phenotypes. Higher scores reflect that the animal has more genetic potential for that particular trait based on the combination of DNA markers analyzed. The higher scores do not necessarily indicate that it is the most desirable.

DNA PROFILE SCORES												
HP	Stay	Mat CE	Doc	ADG	FE	YW	CWT	Marb	RE	Fat	%CH	YG	Tend
8	9	4	9	6	9	4	7	7	8	6	7	7	4

— by Sally Northcutt, American Angus Association director of genetic research

http://www.angus.org/AGI/GenomicEnhancedEpdsFactSheet.pdf


THIRD-PARTY VALIDATED!
THE MVP
OF A new DNA ERA
GeneSTAR®
MOLECULAR VALUE PREDICTIONS
Pfizer Animal Health
Animal Genetics

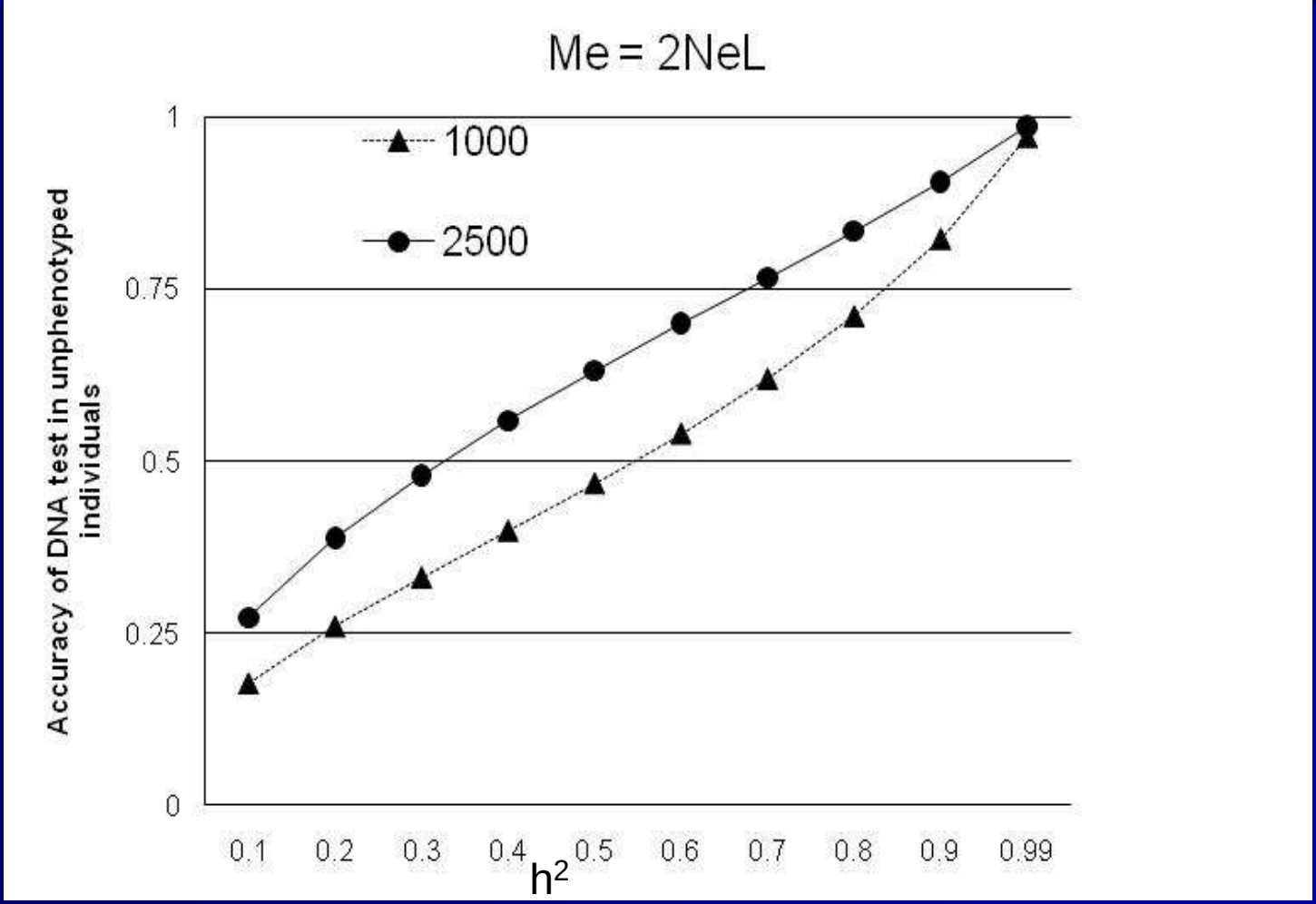
HD 50K MVP Summary

Pfizer Animal Health
Animal Genetics

MVP Summary Statistics					
	Trait	Units	MVP Range	%Reliability	% GV
Calving	CED	%	-17.8 to 21.2	47	22
	BW	lbs	-9.3 to 7.4	53	28
Growth	WW	lbs	-24 to 93	57	32
	ADG	lbs/day	-0.35 to 1.11	55	30
Efficiency	DMI	lbs/day	-2.39 to 2.5	33	11
	NFI	lbs/day	-1 to 1.05	35	12
Maternal	CEM	%	-9.1 to 17.9	63	40
	MA	lbs	-20 to 51	52	27
Carcass	CW	lbs	-20 to 79	54	29
	FAT	inches	-0.13 to 0.17	63	40
	REA	inches^2	-0.82 to 1.25	54	29
Quality	MS	USDA units	-0.33 to 1.79	58	34
	TND	lbs	-1.24 to 0.95	51	26
Index	$MVP^{FL}	--	--	--	--

* More than 5,400 animals genotyped
** *P*-values ≤ 0.0001

Effect of trait heritability on accuracy of DNA tests trained in populations of 1000 (▲) or 2500 (●) individuals with phenotypic observations. Effective population size (N_e) = 100, length of bovine genome (L) = 30 M, effective number of loci (M_e) = 2NeL, and a normal distribution of QTL effects were assumed. Derived from the formula of Goddard (2009).



The tables below display the EPDs for each sire along with the HD 50K MVPs and % ranking for each. HD 50K results reinforce the power of this technology, as the MVPs closely reflect each sire's high-accuracy EPDs. HD 50K MVPs can help to more accurately predict genetic merit in young, unproven animals as early as four months of age, as compared to moderate or high-accuracy EPDs that require years of data.

G A R Predestined															13395344
	CED	BW	WW	YW	ADG	DMI	NFI	CEM	MA	CW	FAT	REA	MS	TND	$B/$MVP[FL]
EPD	7	4.1	53	99	-	-	-	6	28	26	0.046	0.59	1.07	-	69.78
ACC	0.84	0.97	0.96	0.94	-	-	-	0.8	0.85	0.82	0.81	0.82	0.84	-	-
EPD % Rank	**30**	**85**	**15**	**15**	**-**	**-**	**-**	**55**	**10**	**4**	**90**	**2**	**1**	**-**	**1**
MVP	13	1.0	37	-	0.45	0.97	0.04	8	33	55	0.07	0.92	1.52	-0.43	243
MVP % Rank	**3**	**70**	**10**	**-**	**30**	**90**	**90**	**4**	**1**	**1**	**90**	**1**	**1**	**80**	**1**

G A R Retail Product															13395329
	CED	BW	WW	YW	ADG	DMI	NFI	CEM	MA	CW	FAT	REA	MS	TND	$B/$MVP[FL]
EPD	6	2.6	47	93	-	-	-	7	25	16	0.003	0.47	0.42	-	55.08
ACC	0.92	0.98	0.96	0.95	-	-	-	0.87	0.91	0.7	0.7	0.73	0.74	-	-
EPD % Rank	**45**	**60**	**35**	**20**	**-**	**-**	**-**	**40**	**25**	**30**	**35**	**5**	**30**	**-**	**10**
MVP	8	1.1	26	-	0.43	0.44	-0.37	4	25	34	0.02	0.54	0.71	-0.43	167
MVP % Rank	**20**	**70**	**40**	**-**	**40**	**80**	**10**	**20**	**9**	**6**	**80**	**2**	**10**	**80**	**15**

H S A F Bando 1961															13896250
	CED	BW	WW	YW	ADG	DMI	NFI	CEM	MA	CW	FAT	REA	MS	TND	$B/$MVP[FL]
EPD	2	2.4	55	97	-	-	-	7	27	20	0.037	0.08	0.25	-	41.51
ACC	0.89	0.96	0.94		-	-	-	0.59	0.71	0.42	0.44	0.53	0.49	-	-
EPD % Rank	**80**	**55**	**15**	**15**	**-**	**-**	**-**	**40**	**15**	**15**	**85**	**60**	**55**	**-**	**45**
MVP	-2.0	2.4	43	-	0.37	0.32	-0.28	4.5	29	40	0.03	-0.08	0.24	-0.54	105
MVP % Rank	**90**	**90**	**5**	**-**	**70**	**70**	**30**	**20**	**3**	**2**	**80**	**90**	**70**	**60**	**60**

Lead Today with 50K

Take selection and marketing decisions to the next level by taking advantage of HD 50K, the first commercially available predictions utilizing a High-Density panel of more than 50,000 markers. Available initially for Angus owners, a one-time sample submission provides the opportunity for ongoing access to MVPs for future unique traits and technology advancements. The suite of 14 genomic trait predictions, including the beef industry's first DNA-based economic index, provides MVPs for economically important traits not available as EPDs like average daily gain, dry matter intake, net feed intake and tenderness, as well as many that complement EPDs.

For more information about HD 50K:

HD 50K Overview

HD 50K Customer Reporting Overview

FAQs

HD 50K Television Ad

Post a Question

Order a Test Kit

Cost per test

1-24	$129
25 +	$119

Existing samples reanalyzed

1-24	$ 79
25+	$ 69

MetaMorphix Incorporated

- Tru-Marbling™
- Tru-Tenderness™
- Tru-Back Fat™
- Tru-Rib Eye™
- Tru-ADG™
- Tru-Yield Grade™

MMI Genomics, Inc.

BREED TRU

DNA VERIFIED

Work in Your Best Genes

TRU-MARBLING™

FEATURES

- Contains 128 DNA markers where each marker is highly associated with expression of marbling score
- Measures the cumulative effects of all 128 markers associated with marbling
- Results are expressed as the Molecular Genetic Value (MGV) which can be utilized to rank animals by their genetic potential
- Animals can be tested at any age
- Validated in Angus (validation in other breeds is underway)

BENEFITS

- The most powerful and comprehensive DNA selection tool currently available for marbling
- Accounts for a significant proportion of total observed genetic variation for marbling
- Results are easy to utilize and incorporate into any existing breeding program
- Can be used to make early selection and breeding decisions
- Provides accurate and reliable results for ranking and/or selection of animals

One in a series of break-through products that will advance breeding practices in the cattle industry, *Tru-Marbling*™ is a powerful and comprehensive DNA selection tool that can determine the genetic potential of animals to express marbling. In a collaborative research program between Cargill and MMI Genomics, an innovative scientific approach was used on over 4000 feedlot animals to identify the majority of regions throughout the bovine genome that have an effect on this economically important trait.

Tru-Marbling™ is a DNA-based genetic test that contains a panel of 128 unique DNA markers, each one highly associated with the expression for marbling score and quality grade. By measuring the cumulative effects for each of these 128 markers, *Tru-Marbling*™ accounts for a significant proportion of the total genetic variation for this complex metabolic trait—the first DNA-based product to do so!

Tru-Marbling™ is an advanced and revolutionary tool that will allow cattle producers to make early breeding decisions that **increase the accuracy** of selection and **decrease the age** at which animals can be selected.

The results? Rapid improvement of marbling within herds and the ability to determine the "Tru" genetic potential of animals.

PROVEN RESULTS

Tru-Marbling™ has been validated in both commercial cross-bred feeder cattle populations and in Angus cattle.

The validation in Angus was conducted using samples from the National Carcass Merit Project, representing Angus sires bred to Angus-based commercial cows. While this is a small population of animals, the data indicate that *Tru-Marbling*™ **accounts for 70% of the genetic variation** observed in this population.

No. of samples:	**414**
Heritability*:	**0.36**
No. of markers:	**128**
Phenotypic variation explained (R^2):**	**0.25**
As a percent of Heritability	**70%**

** Angus National Cattle Evaluation, Spring 2007*

*** estimated from a model that included contemporary group and MGV*

Tru-Marbling™ has also been validated against commercial cross-bred feeder cattle populations.

Explains 70% of the genetic variation in marbling with 128 markers

FEATURES

- Contains 11 DNA markers where each marker is highly associated with expression of tenderness in meat products
- Measures the cumulative effects of all 11 markers associated with meat tenderness
- Results are expressed as the Molecular Genetic Value (MGV) which can be utilized to rank animals by their genetic potential
- Animals can be tested at any age
- Validated in Angus (validation in other breeds is underway)

BENEFITS

- The most powerful and comprehensive DNA selection tool currently available for tenderness
- Accounts for a significant proportion of total observed genetic variation for tenderness
- Results are easy to utilize and incorporate into any existing breeding program
- Can be used to make early and accurate selection and breeding decisions
- Provides accurate and reliable results for ranking and/or selection of animals

MMI Genomics, Inc.
BREED TRU
DNA VERIFIED
PROVEN TECHNOLOGY
PROVEN RESULTS
PROVEN PROFITS

1756 Picasso Avenue
Davis, CA 95618
1.800.311.8808
www.breedtru.com

Work in Your Best Genes

TRU-TENDERNESS™

One in a series of break-through products that will advance breeding practices in the cattle industry, *Tru-Tenderness*™ is a powerful and comprehensive DNA selection tool that can determine the genetic potential of animals to produce tender meat. In a collaborative research program between Cargill and MMI Genomics, an innovative scientific approach was used on over 4000 feedlot animals to identify the majority of regions throughout the bovine genome that have an effect on this valuable consumer trait.

Tru-Tenderness™ is a DNA-based genetic test that contains a panel of 11 unique DNA markers, each one highly associated with expression for tender meat. By measuring the cumulative effects for each of these 11 markers, *Tru-Tenderness*™ accounts for a substantial proportion of the total genetic variation for this complex metabolic trait.

Since tenderness can only be measured in harvested cattle it is difficult, time consuming and expensive to make genetic progress for this trait using traditional genetic improvement tools. *Tru-Tenderness*™ changes this paradigm by allowing producers to accurately assess the genetic potential of their breeding stock to produce tender meat. In addition, *Tru-Tenderness*™ also shortens the interval for making genetic progress because it can be used to test animals of any age.

Tru-Tenderness™ is an advanced and revolutionary tool that will allow cattle producers to make early breeding decisions that **increase the accuracy** of selection and **decrease the age** at which animals can be selected.

The results? Rapid improvement of tenderness within herds and the ability to determine the "Tru" genetic potential of animals.

PROVEN RESULTS

Tru-Tenderness™ has been validated in Angus using samples from the National Carcass Merit Project, representing Angus sires bred to Angus-based commercial cows. While this is a small population of animals, the data indicate that *Tru-Tenderness*™ accounts for 100% of the genetic variation observed in this population as measured by Warner-Bratzler shear force.

No. of samples:	**407**
Heritability*:	**0.35**
No. of markers:	**11**
Phenotypic variation explained (R^2):**	**0.38**
As a percent of Heritability	**100%**

* as estimated in Minick et al, 2004, Can. J. Anim. Sci. 84:599

100% accurate

Explains 100% of the genetic variation in marbling with 11 markers

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METAMORPHIX LICENSES ITS DNA-BASED MARKER TECHNOLOGY TO BEEFTEK

BeefTek to Incorporate MetaMorphix's Predictive DNA-based Markers in their Integrated Beef Production System

BELTSVILLE, MD and HOUSTON, TX – November 20, 2009 – MetaMorphix, Inc. (MMI) and BeefTek today announced that MMI has granted BeefTek an exclusive license to use its predictive markers in an integrated beef production system. The financial details of the agreement have not been disclosed.

BeefTek is developing an integrated beef production system that it expects will provide high quality beef with improved production economics. BeefTek's production system will initially employ MMI's predictive markers to select cattle that have a high potential for marbling which is the primary factor used by the USDA to determine beef quality. "The beef cattle industry has historically had difficulty meeting consumer demand for high quality beef," said John Lamar, Chairman and CEO of BeefTek. "Using MetaMorphix's genetic markers, which have accurately predicted marbling in studies on several hundred thousand head of cattle, we expect our unique production system will provide a consistent, reliable source of the highest quality beef products."

BeefTek will select cattle using MMI's predictive markers for marbling. Selected cattle will be managed in a system designed specifically to produce high quality beef. BeefTek expects to market the output from this production system to processors and retail distributors that specialize in the high quality beef segment.

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PRIMEMARKER TO DEVELOP AND COMMERCIALIZE METAMORPHIX'S DNA-BASED MARKER TECHNOLOGY IN BEEF CATTLE

MetaMorphix Expands Commercialization of its Predictive DNA-based Markers By Licensing Their Use in Beef Cattle to PrimeMarker

BELTSVILLE, MD and HOUSTON, TX – December 4, 2009 – MetaMorphix, Inc. (MMI) and PrimeMarker today announced that MMI has granted PrimeMarker a license to commercialize its predictive markers in beef cattle. The financial details of the agreement have not been disclosed.

MetaMorphix has developed DNA-based markers that predict how individual cattle will perform with regard to meat quality and production efficiency. In terms of meat quality traits, MMI has tests for marbling, tenderness and rib eye area. In terms of production efficiency traits, MMI has tests for average daily gain and red meat yield. The accuracy of many of these tests has been validated on several hundred thousand head of commercial cattle.

"We are very pleased to have PrimeMarker, with their wealth of experience and knowledge of the beef cattle industry, commercializing our genetic tests," said Dr. Edwin Quattlebaum, MetaMorphix President & CEO. "MMI's focus has been on marketing its marbling test to the feedlot sector. We are excited that PrimeMarker has identified commercial opportunities in essentially every segment of the beef cattle industry, potentially expanding our customer base beyond the feedlot sector to include breeders, cow/calf operators, and processors. Additionally, PrimeMarker expects to commercialize genetic tests for several traits in addition to our current marbling test."

QUANTUM GENETICS

DNA Assisted Feedlot Management

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Quantum Genetics Canada Inc. - Who/what are they?

Quantum Genetics Canada Inc. is a Canadian company created in 2003, located in Saskatoon, Saskatchewan, Canada at Innovation Place Research Park. It is devoted to activities related to research/commercialization and the genetic variation that exists within the populations of animals in the industry. Primarily the company is focused on the identification of variant forms of genes that affect phenotypes of economic importance, i.e. YG, QG, carcass wt, etc. Further understanding of how to manipulate these genotypes to achieve more consistent end products is also at the forefront of QGCI. QGCI has developed one such understanding about how to manipulate variation in the obese gene, such that Canada/USDA grades can be optimally achieved more consistently than have been done with existing technologies.

PRESCRIBE GENOMICS

Prescribe Genomics Co.

Prescribe Genomics Wagyu Tests

Order Form

Cattle DNA Collection Guide

Pfizer Animal Genetics can offer Prescribe Genomic tests. Pfizer Animal Genetics will send DNA from Wagyu samples to the Prescribe Genomics laboratory in Japan for testing. Prescribe Genomics offers two DNA tests: GH Exon 5 and SCD.

GH Exon 5

This test represents a method for evaluating Wagyu cattle for the characteristics of growth rate and marbling using genetic polymorphism of the growth hormone Exon 5. Wagyu variants of this gene are A, B & C, therefore there are six genotypes: AA, AB, AC, BB, BC & CC. Prescribe Genomics suggests the preferred genotypes for producing bulls for F1 production are BB, BC and CC.

SCD

This test is designed to assist in the selection of cattle that show a genotype that produces a superior fat composition. Stearic acid, which corresponds to the amino acid Valine (V), makes deposited fat harder. Oleic acid, which corresponds to the amino acid Alanine (A), makes deposited fat softer, which Prescribed Genomics states is more palatable to the Japanese market. There are three possible genotypes for SCD, these are AA, VA and VV. AA is the preferred type.

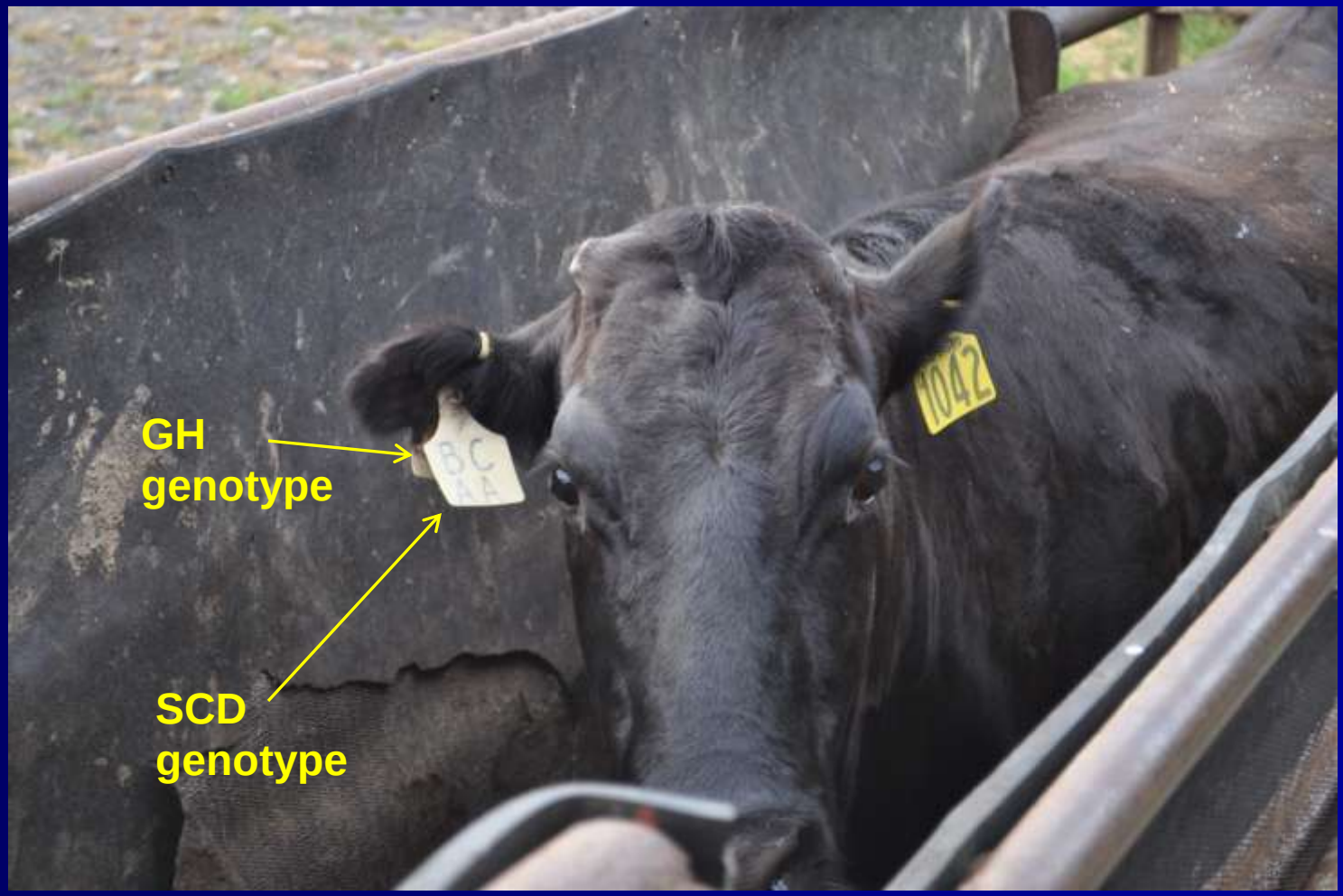
Pricing from:

GH Exon 5 only	$91+GST
SCD only	$82+GST
GH Exon 5 & SCD	$155+GST

~AU$170 per test

All prices are excluding GST

Markers are being used by producers to make selection/breeding decisions!



Black Angus Sire

G A R Predestined

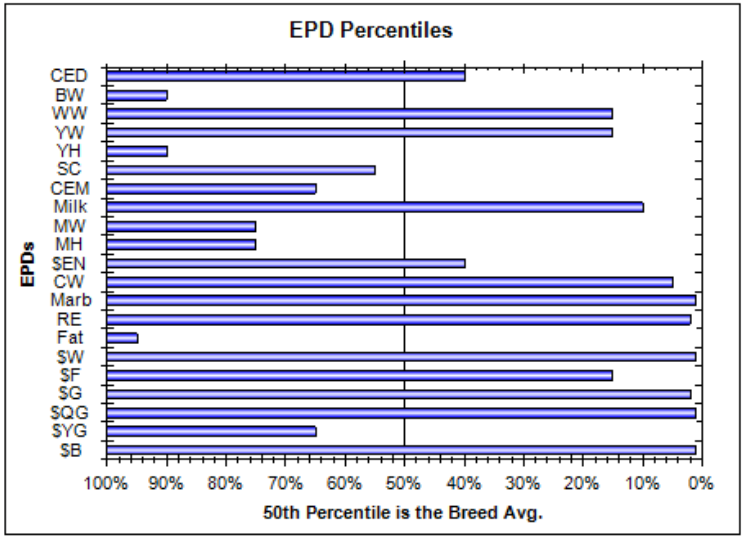
Reg. No.: 13395344
Calved: 8/16/1999
Tattoo: 5899
Semen: $25
Certificates: $20
Spring 2010 EPD

G A R Predestined:
From start to finish--conception to carcass--no other bull in the beef business today adds as much real value to cattle as Predestined. Ranking as the #1 bull for $B in the breed--our customers tell us that their Predestined-sired cattle return the most dollars to their pockets--they know that $B works. Unlike any other 036 son, Predestined tones down size, adds depth of flank, superior feet and legs and a pleasant disposition to his offspring. His conception rate is high and he's been a standout in timed-AI programs. His progeny look good--his bulls are thick and his heifers are fancy--and they always display additional shape and capacity. He ended 2006 as our top-seller and rightfully so--Predestined's many talents for creating value are for real.

Production						Maternal					
CED Acc	BW Acc	WW Acc	YW Acc	YH Acc	SC Acc	CEM Acc	Milk Acc	MkH MkD	MW Acc	MH Acc	EN$
+7 .84	+4.1 .97	+53 .96	+99 .94	+0 .96	+.31 .95	+6 .80	+28 .85	345 1135	+13 .81	+.2 .81	+5.24

Carcass					Usnd	$Values					
CW Acc	Marb Acc	RE Acc	Fat Acc	Grp Prog	UGrp UProg	Wean	Feedlot	Grid	$QG	$YG	Beef
+26 .82	+1.07 .84	+.59 .82	+.046 .81	47 261	4269 11990	37.39	37.08	38.21	35.04	3.17	69.78

GeneStar										
QG1	na	QG2	na	QG3	na	QG4	na	QG GPD	
T1		T2	0	T3	0	-	-	T GPD	-0.35
FE1	na	FE2	na	FE3	na	FE4	na	FE GPD	



Current Sires Percent Breakdown

As of 03/22/2010

Registration #	Tenderness	Fat Thickness	Yield Grade	Ribeye Area	Carcass Weight	Percent Choice	Marbling
13395344	3	6	6	4	2	8	9

EPDs (CW, Marb, RE, Fat) are enhanced by genomic profiles generated by igenity.

G A R Predestined 13395344

	CED	BW	WW	YW	ADG	DMI	NFI	CEM	MA	CW	FAT	REA	MS	TND	$B/$MVP[FL]
EPD	7	4.1	53	99	-	-	-	6	28	26	0.046	0.59	1.07	-	69.78
ACC	0.84	0.97	0.96	0.94	-	-	-	0.8	0.85	0.82	0.81	0.82	0.84	-	-
EPD % Rank	**30**	**85**	**15**	**15**	-	-	-	**55**	**10**	**4**	**90**	**2**	**1**	-	**1**
MVP	13	1.0	37	-	0.45	0.97	0.04	8	33	55	0.07	0.92	1.52	-0.43	243
MVP % Rank	**3**	**70**	**10**	-	**30**	**90**	**90**	**4**	**1**	**1**	**90**	**1**	**1**	**80**	**1**

Recap

- Multigenic marker panels are the norm
- Number of traits and markers growing exponentially
- Less emphasis on which genes the markers are associated with, often not even disclosed
- Some unvalidated tests are available and more are coming
- Multiple different reporting systems (1-10, GPD, MVP, MBV)
- No consistent integration into national cattle evaluations

DO DNA TESTS WORK?

Oct 1, 2009 12:00 PM, By Alison Van Eenennaam

DNA tests hold tremendous promise. But questions remain.

Sales literature claims DNA tests can be used to accurately evaluate genetic potential of cattle at birth, and ultimately improve your bottom line. While it is evident that animals can be genotyped at a young age, producers often ask me, "Do DNA tests work?" The answer to that question is, as with many questions, "It depends."

It depends on your motive for testing, and what you mean by "works." DNA-based tests can be used for various purposes: selection and breeding decisions, feedlot sorting, pedigree verification, and as a marketing tool. Their utility for these applications requires knowledge of both how well they work in cattle populations where they are to be applied, and the cost of testing. In the absence of these two pieces of information, it isn't possible to evaluate the costs and benefits associated with the use of these tests, and so it's not possible to determine if they "work."

Some seedstock producers are testing their bulls to provide potential buyers with DNA information. The value of that information to the buyer is determined by the market. If the value is deemed to be more than the cost of testing and is reflected in

MOST RECENT

Hay Shelters Help Protect From Winds

Agriculture Futures, Livestock Prices Trade Mixed

Young Farmers, Ranchers Face Concerns but Express Optimism

Ranchers Eligible for Assistance With Wolf-Related Livestock Losses

What's With This Cattle Market?

COW CALF WEEKLY

Genetic Merit DNA Profiles

By Jeff Parker 10/27/09
Highview Angus Ranch

A recent article in Beef Magazine by Alison Van Eenennaam (UC-Davis Animal Biotechnology specialist) suggests that DNA tests for genetic merit hold "tremendous promise" but so far that "promise" is about all.

Van Eenennaam says that *"A criticism of the currently available tests is that their ability to predict genetic merit is limited"*. She goes on to say that *"Current estimates of the proportion of genetic variation accounted for by existing tests are generally low (0.0-.10)* We would concur that from a cattle breeder's perspective that is very low and it's further compounded by the fact that it's generally just the marketing companies themselves touting their worth. She further outlines that the companies marketing these tests hold that the marker panels are proprietary and thus confidential. Obviously, this leads to difficulty in validating their worth by unbiased third parties. As a result there is little peer reviewed documentation as to their ability to actually improve traits of economic benefit.

For several years now, we have been monitoring and then comparing some of these new DNA genetic merit values with actual on the ground progeny tests. Within the same or similar traits, to date, there has been little correlation (and in one case a negative one) in traits that cattlemen might actually turn into real dollars.

As always Highview Angus Ranch will monitor these new developments until such a time when "the bugs have been worked out". To be sure, in time these genetic merit DNA panels will hold great value but today they just aren't there yet. Many bio technology insiders suggest the "great stuff" hasn't even been developed. So for now it's just a bunch of promotion and commotion by companies trying to sell what hasn't been proven or even created yet. However, with the rapid rate of discovery, this to will change, and the opportunities might then be endless.

See the link below for the entire article by Alison Van Eenennaam.

http://beefmagazine.com/genetics/selection-tools/1001-dna-test-future/

ARE DNA TESTS FOR YOU?

Mar 1, 2010 12:00 PM, By Alison Van Eenennaam

High-density genetic marker tests are now available. How do they fit in your operation?

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Recently, the DNA testing industry matured from marker tests involving a handful of markers explaining a relatively modest amount (0-10%) of the genetic variation in the target trait, to panels involving hundreds or thousands of markers. This is an exciting development because many of the production traits of interest to beef cattle producers are likely to be controlled by a large number of genes.

The proportion of genetic variation explained by these high-density panels provides producers with a way to quantitatively evaluate the merit of commercial products. Accurate estimates of this proportion should now be the focus of test-panel evaluations. Such estimates will also enable breed associations to incorporate DNA data into expected progeny differences (EPDs).

BIF RECOMMENDATION

DNA tests can be used much more effectively when incorporated into and presented as EPDs as recommended by a recent Beef

MOST RECENT

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COW CALF WEEKLY

Marker-Assisted Selection and Breeding - Windows Internet Explorer

http://animalscience.ucdavis.edu/animalbiotech/Biotechnology/MAS/index.htm

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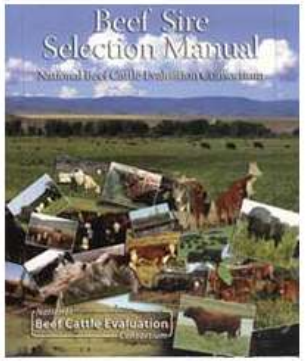
Animal Biotechnology

Marker-Assisted Selection and Breeding

Alison L Van Eenennaam

UCDAVIS University of California, Davis

Biotechnology | Cloning | Transgenics | Concerns | Marker-Assisted Selection | DNA Companies



NBCEC Beef Sire Selection Manual - National Beef Cattle Evaluation Consortium (2006)

DNA markers…Revolution or Evolution? *ABS Breeders Journal* (Fall/Winter 2009) *New!*

Do DNA tests work? *Beef Magazine* (10/09) *New!*

Basics of DNA Markers and Genotyping (6/09)

DNA-Based Progeny Testing (6/09)

Fundamentals of Expected Progeny Differences (6/09)

Marker-Assisted Selection in Beef Cattle Handout (6/09)

The Value of Improving Accuracy of Yearling Bulls (6/09)

Validation of Marker Tests (6/09)

Whole Genome Selection (6/09)

2009 Beef Improvement Federation Conference Proceedings

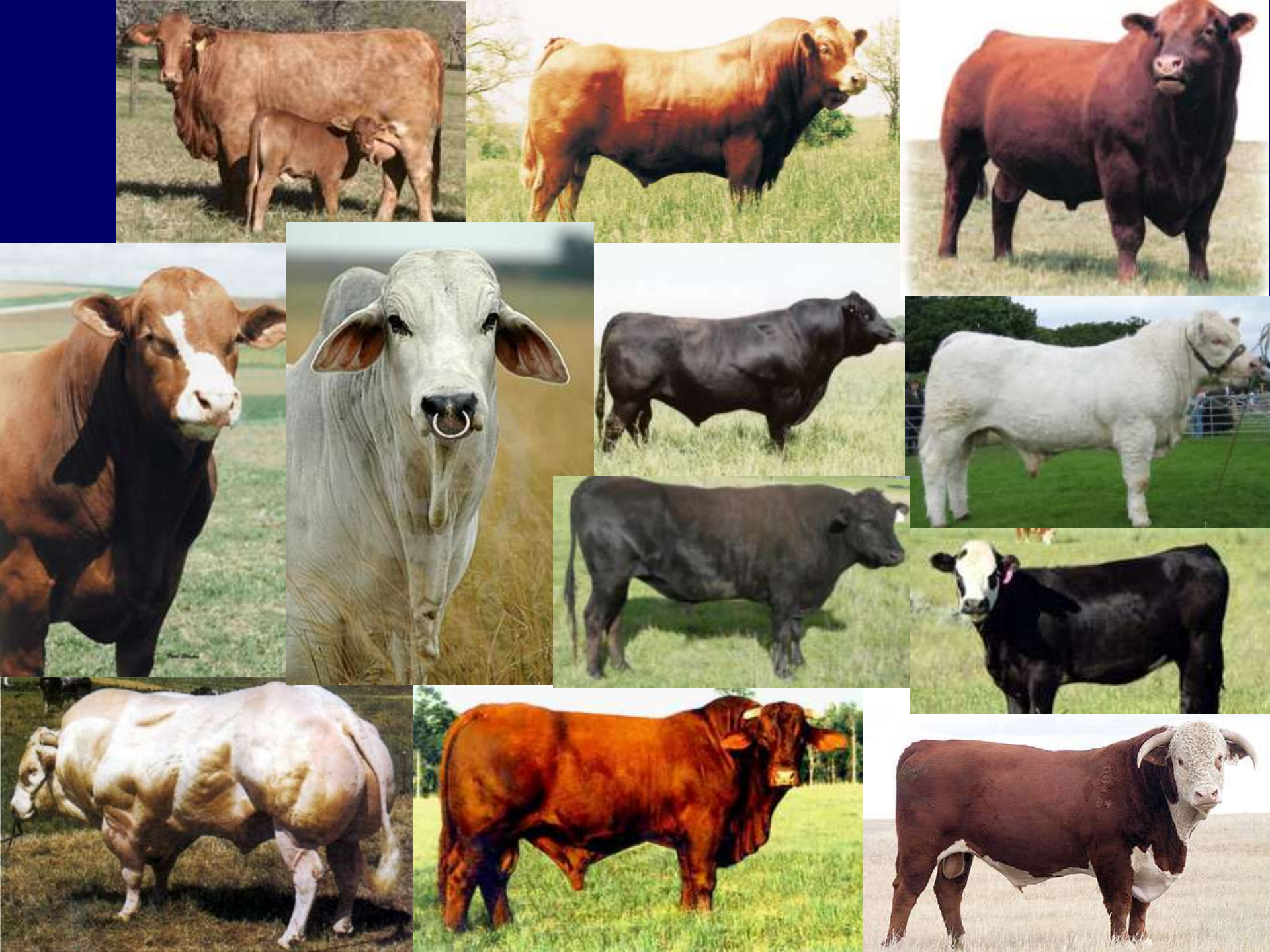
Curly Calf Syndrome (Arthrogryposis Multiplex (AM)) Update (2/09)

Cattlemen to Cattlemen streaming video (5/08)

"No Bull" Discussion on Genetic Markers (5/08)

DNA Markers: Explanation of Validation and Utilization (2007)

Van Eenennaam, A. L. 2006. "DNA-Based Biotechnologies" Pages 66-73 in the National Beef Cattle Evaluation Consortium Beef Sire Selection Manual (2006)



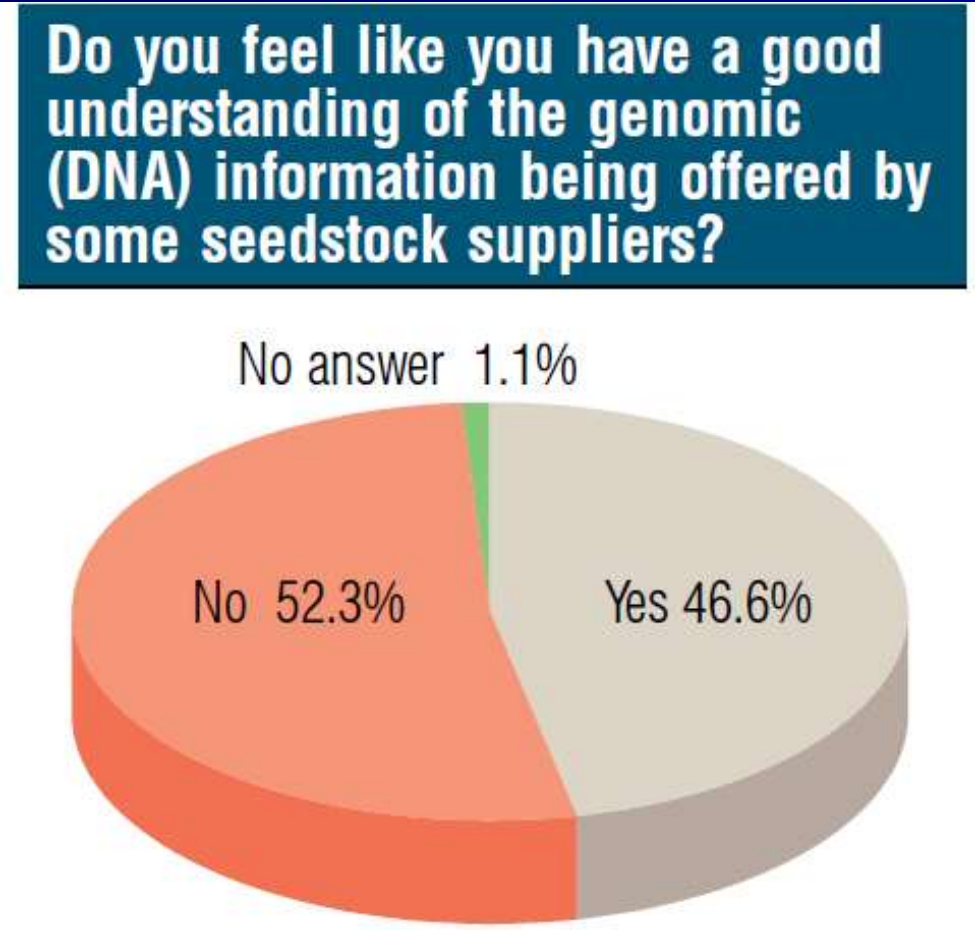
I asked US breed associations the following 2 questions

1. At this stage does your breed association have plans to incorporate DNA tests into any EPDs in the foreseeable future?
2. Is your breed association contemplating the development of a validation population or similar resource?

Breed	Question 1	Question 2.
Angus	Actively pursuing incorporation of Igenity profile scores into carcass marker-assisted EPDs	No
Braford	No	No
Brahman	Yes – no further details	Yes – no further details
Brangus	Yes	Yes, but not completely defined yet
Gelbvieh	Planning to do this but waiting for results from weight trait project – AGI does genetic evaluations so need to provide them with variances/covariances	No
Limousin	Yes for marbling, REA, gain and docility.	No
Maine-Anjou	No – not at this time	Project planned with U of Missouri (Jerry Taylor) to do marker research specific to M-A genetics – have DNA and semen on file there from past project
Salers	No – would like to	Working in conjunction with U of Missouri (Jerry Taylor) to develop Salers database of DNA
Santa Gertrudis	Yes – contemplating inclusion of DNA in genetic evaluation, they are on Breedplan and are in the exploratory phase of doing a joint evaluation	Have not got that far yet – are in the exploratory phase of incorporating something like that to have a direct comparison of Australian and US genetics
Simmental	Yes – waiting for tests to get better. Did have the first marker-assisted tenderness WBSF EPD in but not doing that at the current time	Working with University of Illinois to obtain large population of phenotyped (Grosafe) males offspring from 3 commercial ranches using Simmental (and Angus, Red Angus, Gelbvieh, and composite sires)

March 1, 2010 Beef Magazine Survey

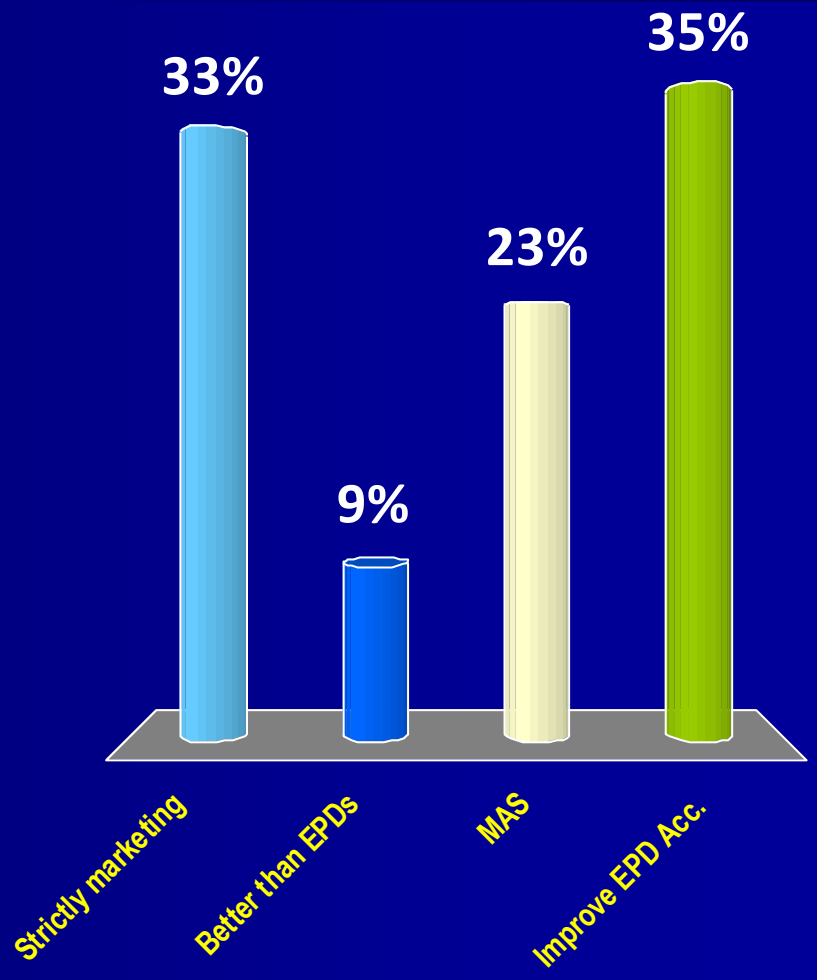
http://beefmagazine.com/genetics/beef-asked-answered-20100301



Base = 635 (All Cow-Calf Operations)

Why do you use DNA tests?

1. Strictly marketing
2. Better than EPDs
3. MAS
4. Improve EPD Acc.



Key messages

- The way test results are being reported in US is confusing, and does not help genetic progress
- This tends to encourage use of DNA results as a sales tool rather than a genetic improvement tool
- Have to integrate DNA data into genetic evaluation

The end