DNA Marker Validation

National Beef Cattle Evaluation Consortium

Colorado State University-Cornell University-University of Georgia

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Commercial genetic test validations

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The purpose of the NBCEC commercial DNA test validation is to independently verify associations between genetic tests and traits as claimed by the commercial genotyping company using phenotypes and DNA from reference cattle populations

The validation process is a partnership of the owners of DNA and phenotypes (e.g., breed associations) and genomics companies, facilitated by the NBCEC

Commercial genetic test validations

Summary

There was no significant association of this test with the trait of Marbling Score in any of the validation populations. However, the GeneSTAR Marbling MVP[1] was found to be significantly associated with percent intramuscular fat (%IMF) in a *Bos indicus*- influenced, and one of two *Bos Taurus* populations. Additionally this test was found to be significantly associated with the quality grade (% choice or better) in the *Bos indicus*- influenced population o f 394 animals, but not the *Bos taurus* "B" validation population.

Significance of the GeneSTAR Marbling MVP* (Molecular Value Prediction)

Population	TRAIT	Panel	b**	F	p	N
North American *Bos taurus* "Pfizer A" validation population	Marbling score***	Marbling	-0.267	3.15	0.961	595
	% IMF	Marbling	0.193	1.76	0.094	282
North American *Bos taurus* "Pfizer B" validation population	Marbling score	Marbling	.120	1.1	0.147	723
	% Choice		-0.032	0.1	0.624	723
	% IMF		0.312	5.26	0.011	785
North American *Bos indicus*-influenced "Pfizer C" validation population	Marbling score	Marbling	0.367	1.73	0.096	392
	% Choice		0.276	3.68	0.028	392
	% IMF		0.659	9.83	0.001	394

* Molecular prediction values (MVP) were provided by Pfizer Animal Genetics based on their 56 SNP panel for Marbling Score, Tenderness and Net Feed intake (residual feed intake).

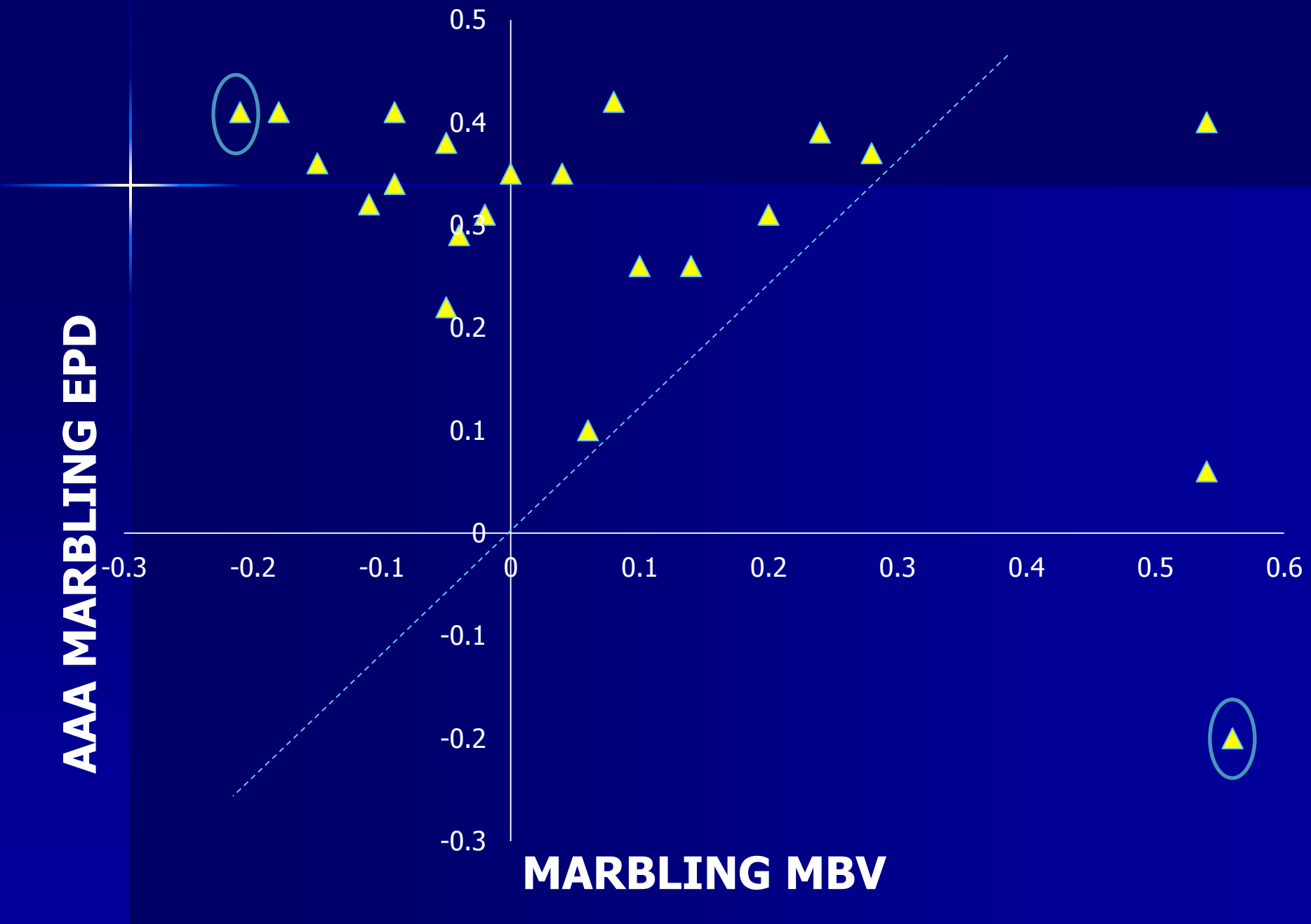
Igenity profile proportion of genetic variance explained by test

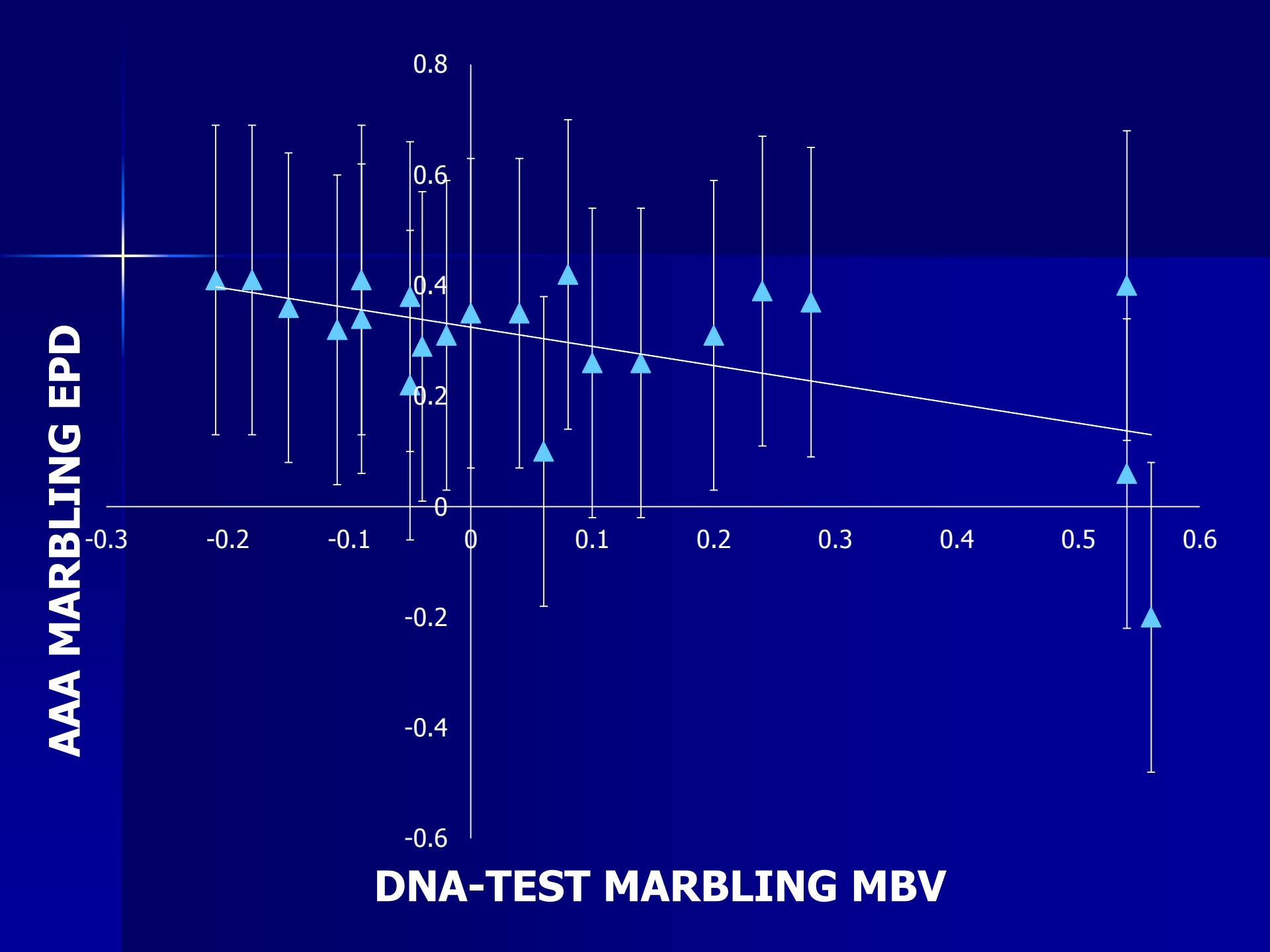
Test	Trait	DS	N	σ^2_P	h^2 (se)	R_g (se)	R_g^2	b (se)	*p*
Igenity Profile MBV	MS	1	1,364	4333	0.72 (0.13)	0.18 (0.04)	3.3	0.76 (0.14)	
	QG	1	1,364	0.22	0.57 (0.12)	0.15 (0.04)	2.1	0.73 (0.19)	0.00009
	YG	1	1,354	0.27	0.84 (0.14)	0.14 (0.03)	2.1	1.17 (0.25)	0.000002
	BF	1	1,364	0.01	0.80 (0.14)	0.11 (0.03)	1.2	0.80 (0.23)	0.0002
	REA	1	1,354	1.11	0.36 (0.11)	0.16 (0.05)	2.6	0.99 (0.30)	0.0005
	ADG	1	1,364	0.23	0.58 (0.13)	0.15 (0.42)	2.2	0.63 (0.16)	0.00007

Pfizer MVP proportion of genetic variance explained by test

Test	Trait	DS	N	σ^2_P	h^2 (se)	R_g (se)	R_g^2	b (se)	*p*
Pfizer MVP Marbling	MS	3	723	2839	0.10 (0.10)	0.13 (0.14)	1.7	11.60 (11.01)	0.147
		4	392	8653	0.44 (0.19)	0.11 (0.09)	1.1	36.01 (27.76)	0.096
	QG	3	723	0.23	0.18 (0.12)	-0.03 (0.09)	0.1	-0.03 (0.10)	0.624
		4	392	0.23	0.31 (0.18)	0.19 (0.11)	3.6	0.28 (0.14)	0.028
	% IMF	3	785	0.45	0.28 (0.12)	0.16 (0.08)	2.7	0.31 (0.13)	0.011
		4	394	0.48	0.40 (0.18)	0.21 (0.10)	4.5	0.51 (0.21)	0.001
Pfizer MVP Tenderness	WBSF (d 14)	2		0.35	0.22 (0.09)	0.32 (0.10)	9.9	0.33 (0.09)	0.00008
	WBSF (d 1)	4	390	0.82	0.12 (0.13)	0.41 (0.27)	17.1	0.38 (0.14)	0.007
	WBSF (d 14)	4	388		Estimate < 0				
Pfizer MVP Feed Efficiency		4	395	0.87	0.30 (0.17)	-0.02 (0.10)	0.03	-0.02 (0.15)	0.55

Equity Angus Farm Marbling




AAA MARBLING EPD
DNA-TEST MARBLING MBV
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.3
-0.2
-0.1
0
0.1
0.2
0.3
0.4
0.5
0.6

TRAIT	Igenity Profile	Pfizer MVP		Pfizer 50K	MMI
			CRC validation		
Average Daily Gain	X			30%	
Net Feed Intake		9%	0-6%	12%	
Dry matter intake				11%	
Residual feed intake	X				
Tenderness	X	24%	2-30%	26%	100%
Calving Ease (Direct)				22%	
Birth weight				28%	
Weaning Weight				32%	
Yearling Weight	X				
Calving ease (maternal)	X			40%	
Milking Ability				27%	
Heifer pregnancy rate	X				
Docility	X				
Stayability	X				
Carcass weight				29%	
Backfat thickness	X			40%	
Ribeye area	X			29%	
Marbling score	~15%	7%	0-4%	34%	70%
Yield Grade	X				
Percent Choice	X				
COST	$58-78			$69-129	$65/145

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.

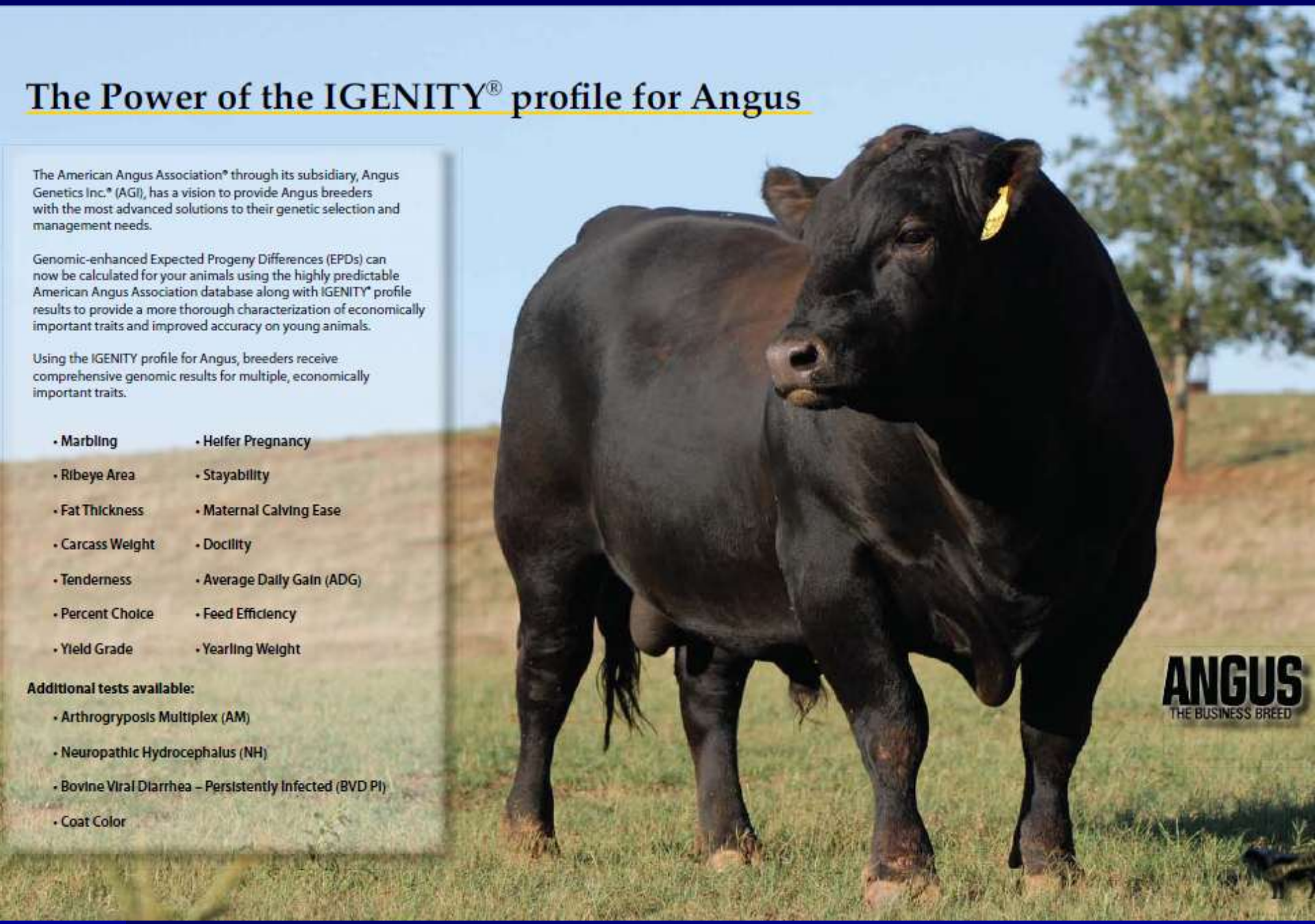
Genomic-enhanced Expected Progeny Differences (EPDs) can now be calculated for your animals using the highly predictable American Angus Association database along with IGENITY® profile results to provide a more thorough characterization of economically important traits and improved accuracy on young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



PFIZER ANIMAL GENETICS Trait	h^2	% Genetic variation explained			
		Pfizer MVP (2009)	Australian Validation (2009)	Pfizer 50K (2010)	Third party Validation?
Average Daily Gain	0.28			30%	?
Net Feed Intake	0.39	9%	0-6%	12%	?
Dry matter intake	0.39			11%	?
Tenderness	0.37	24%	2-30%	26%	?
Calving Ease (Direct)	0.1			22%	?
Birth weight	0.31			28%	?
Weaning Weight	0.25			32%	?
Calving ease (maternal)	0.1			40%	?
Milking Ability	0.25			27%	?
Carcass weight	0.39			29%	?
Backfat thickness	0.36			40%	?
Ribeye area	0.4			29%	?
Marbling score	0.37	7%	0-4%	34%	?

Mock up of Beef Magazine Table

Summary of commerically-available DNA-tests for beef cattle

Production Trait Tests

Company	Test Name	Trait	Company-sponsored external validation study	Date of validation	NBCEC validation requested	**NBCEC Summary Statement** For a more complete summary of each test, visit the NBCEC website at: *http://www.ansci.cornell.edu/nbcec/validation/overview*
Complex traits						
Igenity® www.igenity.com	IGENITY profile	Fat Thickness		12/2008	Yes	The IGENITY profile was found to be significantly associated with marbling score, back fat thickness, quality grade, ribeye area, and yield grade carcass traits and average daily gain in a commercial predominately Bos taurus sample population of 1364 animals. This test was not evaluated on a Bos indicus-influenced or purebred Bos indicus population.
		Marbling Score		12/2008	Yes	
		Quality Grade (% ≥ Choice)		12/2008	Yes	
		Rib Eye Area		12/2008	Yes	
		Yield Grade		12/2008	Yes	
		Average Daily Gain		12/2008	Yes	
		Tenderness	Roslin Institute, CRC			
		Residual Feed Intake (RFI) (for *Bos indicus* influenced cattle)		12/2007	Yes	The IGENITY feed efficiency (Indicus) MBVs were found to be significantly and positively associated with daily feed intake (DFI) and residual feed efficiency (RFI) in a pooled population of ~1270 tropically adapted (TROP) *Bos indicus*-influenced cattle. No significant associations of the feed efficiency (Indicus) MBVs with either
		Dry matter intake (DMI) (for *Bos indicus* influenced cattle)		12/2007	Yes	
		Residual Feed Intake (RFI) (for *Bos taurus* cattle)		6/2008	Yes	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, 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.
		Heifer Pregnancy Rate	In progress		No	
		Stayability (longevity)	In progress		No	
		Maternal Calving Ease	In progress		No	
		Docility	In progress		No	
Angus Genetics Inc www.angus.org	IGENITY profile for Angus	Fat Thickness for Angus cattle	M. D. MacNeil, Personal communication		No	
		Marbling Score for Angus Cattle	M. D. MacNeil et al., J. Animal Sci. 2009[1]		No	
		Rib Eye Area for Angus Cattle	M. D. MacNeil, Personal communication		No	
		Carcass Weight for Angus Cattle	M. D. MacNeil, Personal communication		No	
		Tenderness for angus cattle			No	
		Residual Feed Intake (RFI) for angus			No	
		Yearling weight for Angus Cattle			No	

Mock up of Beef Magazine Table

Pfizer Animal Genetics *www.pfizeranimalgenetics.com*	GeneSTAR® MVP	Feed Efficiency (FE)	See	2/2009	Yes	The GeneSTAR feed efficiency MVP was found to be significantly and positively associated with residual feed intake (RFI) in a North American population of 671 *Bos taurus* cattle. No significant association was found between this MVP and feed efficiency in a North American population of 395 *Bos indicus*-influenced cattle.
	GeneSTAR® MVP	Marbling (Marb)		2/2009	Yes	There was no significant association of this test with the trait of Marbling Score in any of the validation populations. However, the GeneSTAR Marbling MVP was found to be significantly associated with percent intramuscular fat (%IMF) in a Bos indicus- influenced, and one of two *Bos Taurus* populations. Additionally this test was found to be significantly associated with the quality grade (% choice or better) in the *Bos indicus*- influenced population 1394 animals, but not a *Bos taurus* validation population.
	GeneSTAR® Tenderness MVP	Tenderness (Tend)		2/2009	Yes	The GeneSTAR Tenderness MVP was found to be significantly associated with a decrease in Warner-Bratzler shear force (WBSF) measurements (i.e. increased tenderness) at 14 d postmortem in two Bos taurus sample populations. Additionally this test was found to be significantly associated with a decrease in Warner-Bratzler-shear force measurements at day 1 d postmortem, but not 14 d postmortem, in a Bos indicus-influenced population of 390 animals.
	HD 50K for Angus	Calving Ease Direct (CED)			No	
		Birth Weight (BW)			No	
		Weaning Weight (WW)			No	
		Average Daily Gain (ADG)			No	
		Dry matter intake (DMI)			No	
		Net Feed Intake (NFI)			No	
		Calving Ease Maternal (CEM)			No	
		Milking Ability (MA)			No	
		Carcass Weight (CW)			No	
		Fat Thickness (FAT)			No	
		Ribeye Area (REA)			No	
		Marbling Score (MS)			No	
		Tenderness (TND)			No	
		MVP^{FL} (Feedlot & Carcass)			No	
MMI genomics *www.breedtru.com*	Tru-Marbling™	Marbling Score and Quality Grade	Yes - w/Cargill and feedlots	01/2007	No	
	Tru-Tenderness™	Tenderness	Yes - w/Cargill and feedlots	01/2007	No	
	Tru-Back Fat™	Back Fat Grade	Yes - w/Cargill and feedlots	01/2009	No	
	Tru-Rib Eye™	Rib Eye Area Grade	Yes - w/Cargill and feedlots	01/2009	No	
	Tru-ADG™	Average Daily Gain Grade	Yes - w/Cargill and feedlots	01/2007	No	
	Tru-Yield Grade™	Yield Grade	Yes - w/Cargill and feedlots	01/2009	No	

[b] MacNeil, M. D., J. D. Nkrumah, and S. L. Northcutt. 2009. Genetic evaluation of Angus cattle for carcass marbling using ultrasound and genomic indicators. Journal of Animal Science. In press.

The selection response and resultant value from using markers depends on

- which trait the test is for and its accuracy in the absence of DNA information
- % of genetic variation explained by the DNA test
- the value of a unit of genetic improvement
- do YOU get paid for that trait?
- Results will be herd-specific and cannot be generalized
- Ideally DNA results will be integrated into EPDs so there is only one source of information

The end