DNA Marker Validation

National Beef Cattle Evaluation Consortium

Colorado State University-Cornell University-University of Georgia

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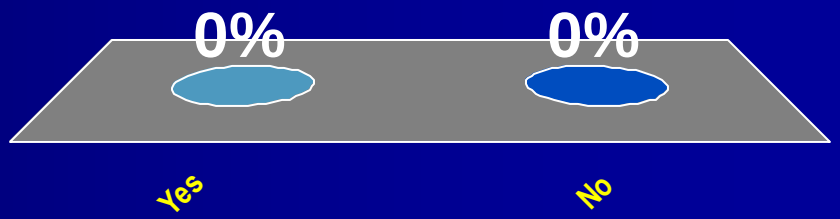
Who has ever looked at the NBCEC validation website?

1. Yes
2. No



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Genetic Test Validation Results

The National Beef Cattle Evaluation Consortium (NBCEC) is an organization of researchers, educators, producers and industry leaders focused on genetic evaluation of beef cattle. Its mission is to advance U.S. beef genetics, increase the sustainability and competitiveness of the beef industry, and provide consumers with affordable and healthy beef products. NBCEC shows this commitment through research, animal evaluation, genetic test validation, industry collaboration and outreach, and professional development.

Genetic Test Validation – NBCEC provides independent, unbiased, third-party validation of genetic tests for the beef cattle industry. See a variety of test results and the validity of the claims.

Current Projects – NBCEC conducts comprehensive, innovative and science-based beef cattle genetic research. Learn about the variety of their current projects.

Sire Selection Manual – This comprehensive manual features a variety of NBCEC research and genetic technology that producers can apply to their farms and ranches.

Nebraska Beef Meeting at MARC – DNA Technology: Where we've been, where we are, and where we're headed. Clay Center, Nebraska – June 22, 2009 . (Please RSVP if attending)

Featured Producer

Jack Cowley, Commercial Producer, Montague, CA

"The NBCEC is critically important to the future of the beef industry during this time of economic uncertainty, reduced land availabilty and increasing demands from the public. The NBCEC is striving to genetically improve beef cattle to be more efficient, while producing a product that is nutritious, healthy and tastes good."

Commercial genetic test validations

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

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Commercial genetic test validations

Overview | Pfizer Animal Genetics (Bovigen) | IGENITY | MMI Genomics | Ancillary Results

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	

GeneSTAR - Windows Internet Explorer

http://www.nbcec.org/ucdavis/GeneSTAR.htm

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GeneSTAR

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GeneSTAR Tenderness MVP

GeneSTAR Marbling MVP

GeneSTAR Feed Efficiency MVP

Peer-reviewed studies

Company website

Other third-party validation reports

Commercial genetic test validations

IGENITY Carcass Composition and Average Daily Gain

IGENITY Tenderness

IGENITY Maternal Traits

IGENITY Docility

IGENITY Feed Efficiency for Bos indicus-influenced cattle

IGENITY Feed Efficiency for Bos taurus cattle

Peer-reviewed studies

Company website

igenity

Last updated 02/10/2009

Commercial genetic test validation

Igenity profile Carcass Composition and Average Daily Gain

igenity

Summary

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.

Significance* of the Igenity Molecular Breeding Values for Carcass Traits and Average Daily Gain

Breed	TRAIT	Panel	b**	F	p	N
Commercial Validation population	**USDA Marbling Score**	MBS	0.76	28.6	0.0000001	1354
	Backfat Thickness	BFAT	0.81	12.46	0.0002	1354
	Quality Grade[1] (% ≥ Choice)	% ≥ CHOICE	0.73	14.06	0.00009	1364
	Ribeye Area	REA	1.01	10.99	0.0005	1354
	Yield Grade	YG	1.16	21.98	0.000002	1354
	Average Daily Gain	ADG	0.61	14.69	0.00007	1364

* Molecular breeding values (MBVs) for each trait were provided by Igenity based on the various SNP panels for each trait.

Commercial genetic test validations

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.

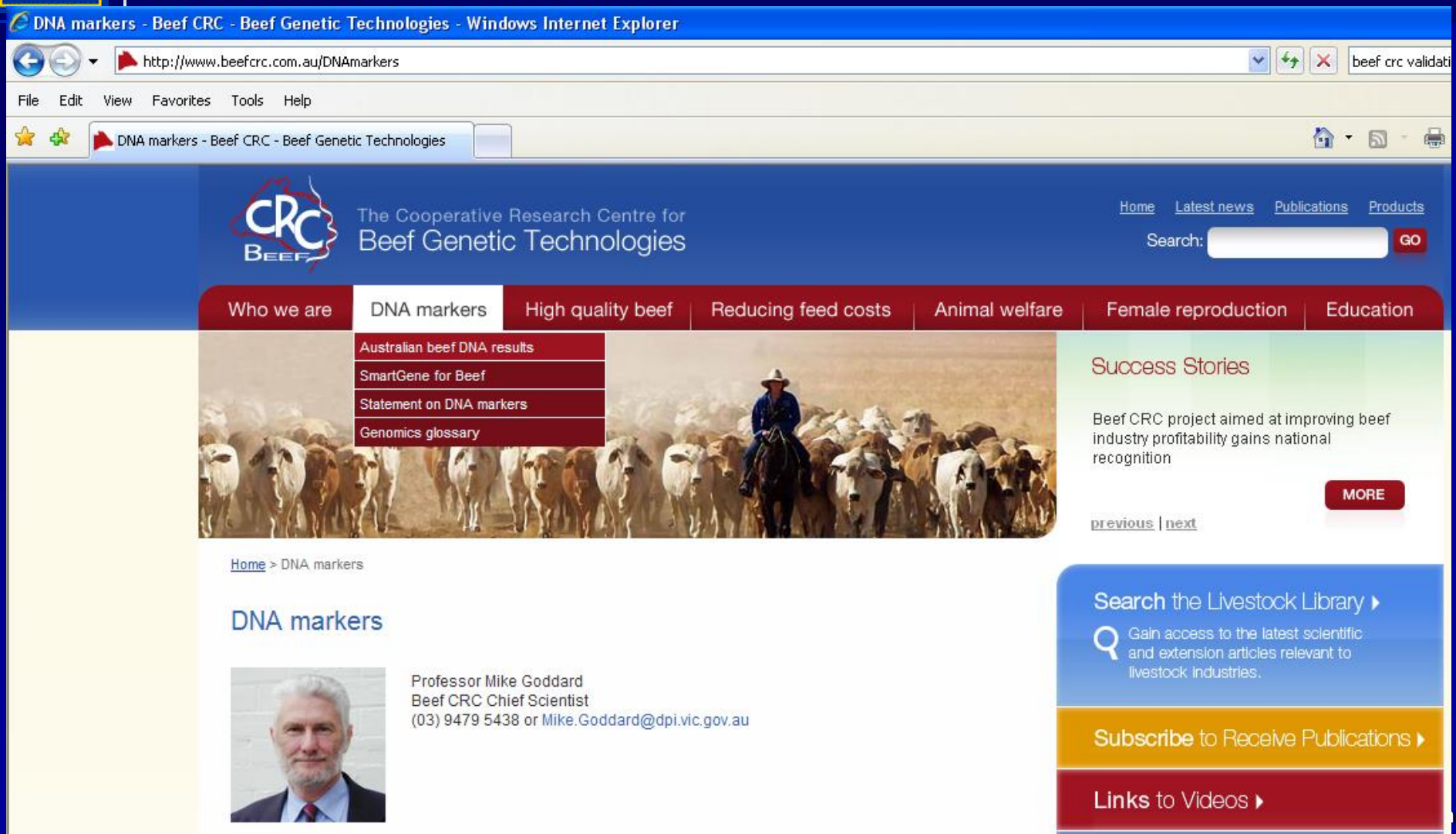
TEST DATASET	Trait	PANEL	b	P	N
TEMPERATE[1] (CRC1)	RFI	TAURUS	0.309	0.04	~546
SHORTHORN[1] (CRC)	RFI	TAURUS	0.393	0.17	~189
ANGUS (CRC)[1]	RFI	TAURUS	-0.426	0.95	~327
NORTH AMERICAN BOS TAURUS[2]	RFI	TAURUS	0.351	0.005	~706
NORTH AMERICAN CHAROLAIS[3]	RFI	TAURUS	0.022	.443	~393
NORTH AMERICAN ANGUS[3]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

An increasingly relevant question in evaluating commercial DNA tests is "*What proportion of the additive genetic variation in the target trait is accounted for by the test?*"



Australian beef DNA results - Beef CRC - Beef Genetic Technologies - Windows Internet Explorer

http://www.beefcrc.com.au/Aus-Beef-DNA-results

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Beef CRC project aimed at improving beef industry profitability gains national recognition

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Australian beef DNA results

As part of its role in delivering DNA markers to the Australian beef industry, Beef CRC has agreed to independently test new panels of DNA markers as they are commercialised by companies such as Pfizer Animal Genetics, Igenity /Merial and Metamorphix Inc.

Results of all independent testing of commercially-available DNA markers undertaken by Beef CRC will be presented on this site, outlining the size and direction of effect and the amount of genetic variation that is accounted for by each panel of markers for the different traits (e.g. marbling, feed efficiency, tenderness etc).

Additional information is provided to help beef businesses interpret the results for themselves to determine the value to their own businesses from an investment in the particular panel of DNA markers.

Those decisions very much depend on the individual business' attitude to risk and can only be made effectively by the individual business.

It is possible that the panel of markers has also been independently evaluated in North American herds by the US National Beef Cattle Evaluation Consortium, so for further information on the size and direction of effect of the markers in those populations, please visit http://www.ansci.cornell.edu/nbcec/

Pfizer GeneStar results

Pfizer interpretation

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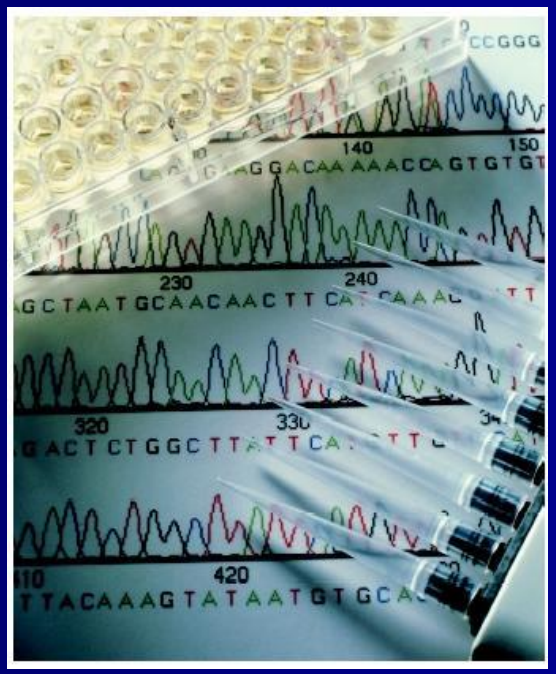
Table 3: Bivariate animal model results using all phenotypes and GeneSTAR MVPs from the 56 marker pane Version January 2009. Results are from a data combining breeds and fitting breed in the model. The residual effect for the MBV was fixed at 0.001 and the residual correlation at 0.0. σ^2_P = phenotypic variance of the observed data after fitting the models, h^2 = heritability of the trait, note MVP have a heritability of very close to1.0, r_g = genetic correlation between MVP and target trait, r_g^2 = % genetic variance explained by marker, **b** = regression coefficient of MVP on phenotype has been calculated as ratio of covariance over variance of MVP. Standard errors of estimates are in brackets.

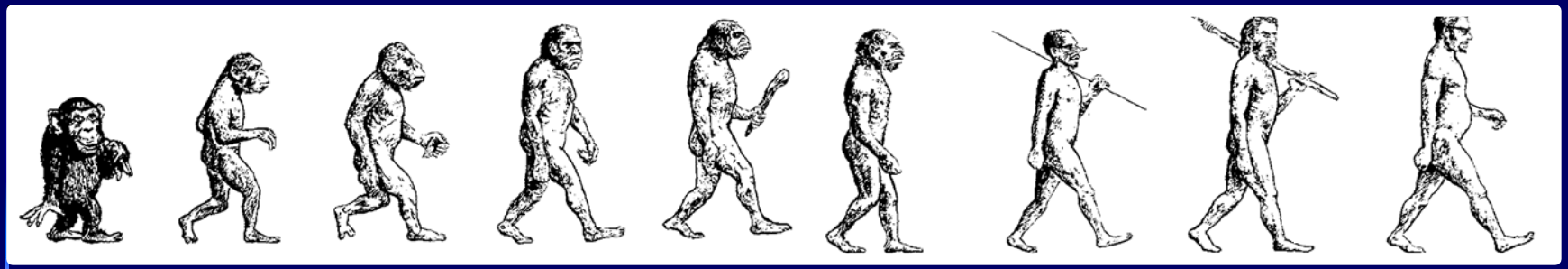
Test	Trait	Data	N		σ^2_P	h^2 (se)	r_g (se)	r_g^2	b (se)
Pfizer MVP Marbling	IMF	1	Phenot =	3,594	2.035	0.39 (0.06)	0.054 (0.07)	0.3	0.255 (0.30)
			MVP =	703	0.035				
		2	Phenot =	3,524	0.978	0.37 (0.06)	0.064 (0.07)	0.4	0.231 (0.24)
			MVP =	668	0.027				
		3	Phenot =	876	0.767	0.23 (0.10)	0.011 (0.13)	0.0	0.028 (0.33)
			MVP =	253	0.026				
		4	Phenot =	878	0.717	0.37 (0.11)	0.121 (0.11)	1.5	0.415 (0.39)
			MVP =	225	0.022				
Pfizer MVP Marbling	MSA MS	1	Phenot =	1,454	0.281	0.35 (0.09)	0.131 (0.12)	1.7	0.218 (0.20)
			MVP =	710	0.035				
		2	Phenot =	1,808	0.236	0.37 (0.08)	0.096 (0.08)	0.9	0.171 (0.15)
			MVP =	670	0.027				
		3	Phenot =	594	0.211	0.31 (0.13)	0.016 (0.14)	0.0	0.024 (0.22)
			MVP =	253	0.026				
		4	Phenot =	636	0.229	0.19 (0.11)	0.189 (0.17)	3.6	0.262 (0.23)
			MVP =	225	0.022				
Pfizer MVP Tenderness	LDSF	1	Phenot =	3,322	0.433	0.08 (0.04)	0.170 (0.14)	2.9	0.109 (0.09)
			MVP =	659	0.088				
		2	Phenot =	3,254	0.612	0.30 (0.06)	0.283 (0.08)	8.0	0.301 (0.09)
			MVP =	585	0.160				
		3	Phenot =	785	0.658	0.26 (0.10)	0.126 (0.14)	1.6	0.137 (0.16)
			MVP =	253	0.142				
		4	Phenot =	762	0.871	0.31 (0.10)	0.547 (0.13)	29.9	0.747 (0.18)
			MVP =	225	0.142				
Pfizer MVP Feed Efficiency	NFI	1	Phenot =	785	0.840	0.14 (0.11)	0.248 (0.15)	6.2	0.300 (0.13)
			MVP =	706	0.079				
		2	Phenot =	687	0.687	0.21 (0.13)	0.232 (0.11)	5.4	0.366 (0.15)
			MVP =	671	0.056				
		3	Phenot =	254	1.110	0.21 (0.25)	-0.044 (0.16)	0.2	-0.074 (0.27)
			MVP =	253	0.082				
		4	Phenot =	215	0.958	0.37 (0.26)	-0.053 (0.14)	0.3	-0.131 (0.33)
			MVP =	225	0.056				

How useful are validation results to producers?

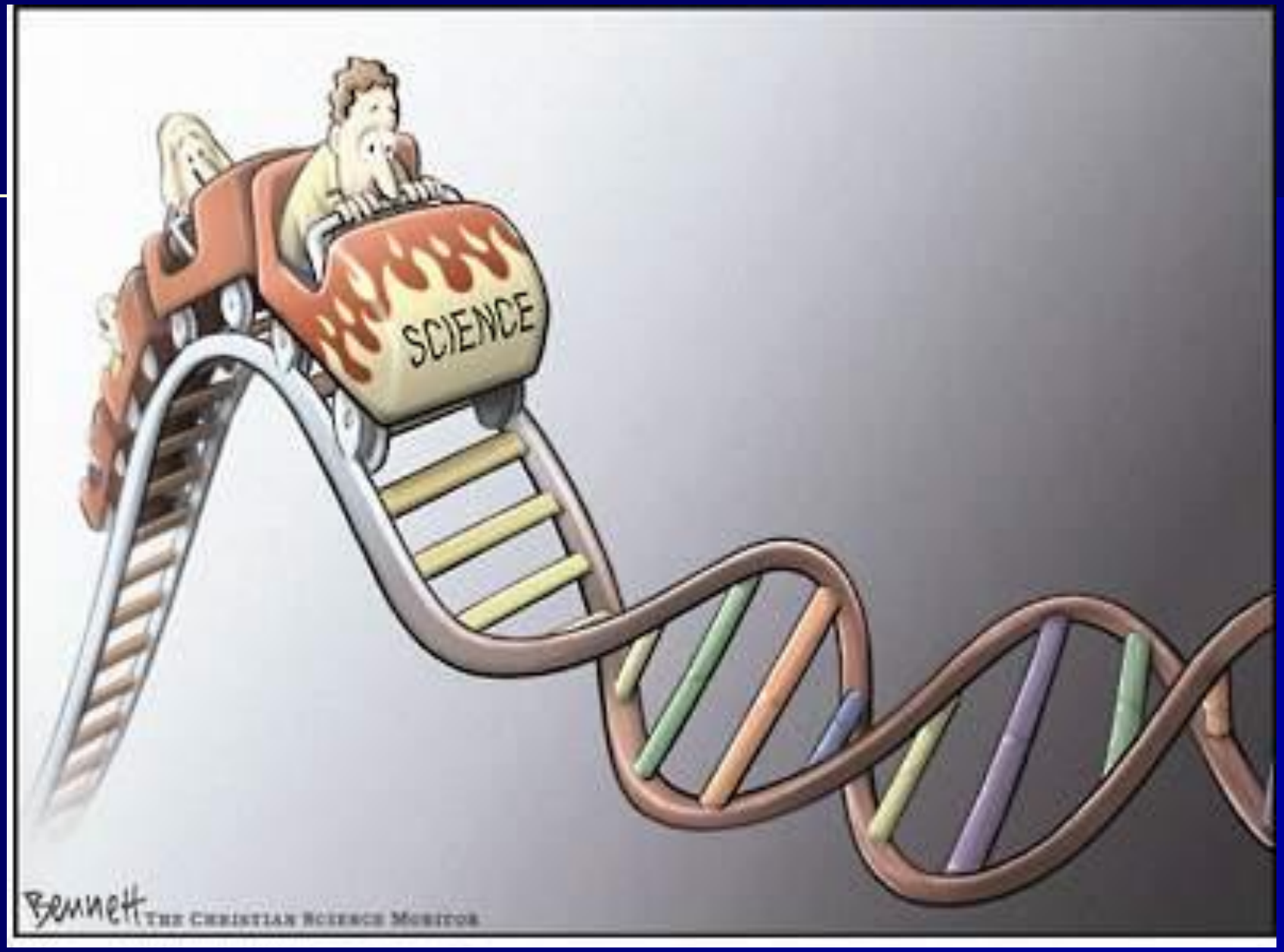
It is not clear how reporting findings that a test explains a proportion ranging from 0 to 0.15 of the additive genetic variation associated with the target trait, has a regression coefficient of 0.26 (±0.3), and a *p* value of 0.001 provides information that helps in the decision-making process.

Publishing traditional EPDs and marker information separately, as is currently the case, is confusing and can lead to incorrect selection decisions when marker scores predict only a small proportion of the genetic variance.





2003	2008	2013	2020
• single marker/ single trait • reported genotypes • single marker accounted for very small amount of genetic variation • limited adoption • technology oversold	• multimarker tests for a few traits reported in a variety of formats • no tie between DNA test results and national genetic evaluation • tests accounted for small proportion of additive genetic variation • limited validation • technology not in a form producers could use	• panels with hundreds of markers for many traits • results reported in units of the trait • incorporation of DNA information into national genetic evaluation • DNA-based evaluations improve accuracy of EPDs • large numbers of genotyped populations are available for validation	• universal marker panel used by worldwide beef cattle community • mandatory, seamless submission of genotype data to national genetic evaluation/breed associations • cost is low and industry uses DNA information for herd management feedyard sorting, and breeding.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