

Integrating biotechnologies for the beef cattle industry

Alison Van Eenennaam, Ph.D. Cooperative Extension Specialist Animal Biotechnology and Genomics University of California, Davis (530) 752-7942 alvaneenennaam@ucdavis.edu



Animal Science Seminar 1/28/2008

Animal Genomics and Biotechnology Education



PATERNITY ANALYSIS IN LARGE COMMERCIAL CATTLE RANCH SETTING

Alison Van Eenennaam

Cooperative Extension Specialist Animal Biotechnology & Genomics <u>alvaneenennaam@ucdavis.edu</u>

Daniel J. Drake M. Cecilia T. Penedo University of California, Davis

http://animalscience.ucdavis.edu/animalbiotech/





2006 Cowley Parentage Trial

Blood collected on FTA cards 213 calves 19 bulls Assigned 85.5% Number of calves per bull 1-22 2 bulls sired 23% ■ 5 bulls sired 50%



Animal Biotechnology and Genomics Education



Bull output varies a lot !

Calf Output per Bull





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Carcass value varies a lot !





Gross income varies a lot !







Prather Ranch – Macdoel Northern California



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DNA Sample Collection

- Blood collected on FTA cards from 27 herd sires and 624 calves derived from a multiple-sire pasture
- DNA also collected from semen straws from 8 AI sires
- After AI, entire herd was run as one group with the 27 herd sires







Genotyping





• Genotyping and paternity assignments based on microsatellites (STRs) were done by the UC Davis Veterinary Genetics Laboratory using a panel of 23 cattle markers (P_E =99.9%)

 Genotyping based on SNPs were done by a commercial genotyping company using a panel of 28 loci <u>\$9.99/sample</u> (PE=95.5%)





Results of the paternity analysis





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	23 Microsatellite (STR) panel		
One possible sire	533*	85.4%	
More than one sire	4	0.6%	
All excluded	76	12.2%	
Resubmits	11	1.8%	
TOTAL	624		

DNA from more than one animal

* 10 assignments allowed a one locus mismatch



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	23 Microsatellite (STR) panel		28 SNP panel	
One possible sire	533*	85.4%	175	23.3%
More than one sire	4	0.6%	420	67.3%
All excluded	76	12.2%	29	4.6%
Resubmits	11	1.8%	0	0%
TOTAL	624		624	

* 10 assignments allowed a one locus mismatch

Unambiguous Assigment of Calves to a Single Sire Using a 28 SNP Panel versus a 23 STR Panel



Number of bulls in pasture







A. L. Van Eenennaam, R. L. Weaber, D. J. Drake, M. C. T. Penedo, R. L. Quaas, D. J. Garrick, E. J. Pollak. 2007. DNA-based paternity analysis and genetic evaluation in a large commercial cattle ranch setting. Journal of Animal Science. 85:3159–3169



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Many commercial companies now offering DNA-services to livestock producers







Animal E	Biotec d Selectio	hnolog	y ng
Alison L Van E	enennaam		
Biotechnology	Cloning	Transgenics	Concern
	A		DNA Ma Utilizatio

Home Genomics



NA Markers: Explanation of Validation and ilization (2007)

My Lab Links News Outreach

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

Aarker-Assisted Selection and Breeding

Marker Assisted Selection

sity of California, Davis

Marker-Assisted Selection in Beef Cattle Handout (4/07)

Marker-Assisted Selection in Beef Cattle Slide Show

Marker-Assisted Selection DNA Backgrounder Handout

<u>Peer-reviewed studies</u> on current commercial DNA marker tests

Selection Manual

National Beef Cattle Evaluation Consortium

Companies

Biogenetic Services

Cattle: Parentage, freemartin, coat color, leptin, meat quality, BSE resistance, Johne's disease Sheep: Scrapie, Spider lamb syndrome Fish: Whirling disease

Bovigen

Cattle: GeneSTAR[®] Quality Grade*, GeneSTAR[®] Tenderness*, GeneSTAR[®] BLACK, parentage, identity tracking

GeneSeek

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

Sheep: Scrapie

Cattle: Parentage, coat color, Seek-Black, Seek

Current listing of DNA companies maintained on "UC Davis Animal Biotechnology" website

http://animalscience. ucdavis.edu/ animalbiotech





What is a Genetic Marker ?

A DNA sequence variation that has been associated with a given trait in one or more populations







Companies that are offering DNA tests for marker-assisted selection for beef cattle traits





Marker-assisted selection (MAS)

The process of using the results of DNAmarker testing to predict the **genetic** merit of the animal being tested and assist in the selection of individuals to become parents in the next generation. The word "assisted" implies that the selection is also influenced by other sources of information, such as animal's observed performance and EPD.



Tests for quantitative traits – currently 10-100 SNPs

- Meat Tenderness
- Quality Grade (Marbling)
- Beef Cattle Feed Efficiency
- Meat Yield
- Disease Resistance
- Dairy Form
- Milk and Milk Component Yield





http://www.nbcec.org/nbcec/

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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

Home

Background

Sample Populations

Marker Assisted Selection

Glossary

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.



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Producer outreach on MAS





Many unvalidated MAS tests are available and more are coming

Bovigen – feed efficiency

- "GeneSTAR® Feed Efficiency consists of four markers which together identify as much as a 15% difference in daily feed consumption with no effect on other traits like Average Daily Gain, Carcass Weight, Quality Grade or Yield Grade" according to company website
- Igenity Yield Grade, Fat thickness, Marbling, Hot carcass weight, Ribeye area
- MMI Average daily gain (not available yet)



"MAS is about to go nuclear"

58,000 SNP bovine CHIP array is now available (Illumina 58k bovine panel) This single enormous test panel which costs ~ \$500 per animal will immediately characterize the entire genome and estimate the value of every chromosome fragment contributing variation in a population with phenotypic observations







USDA Announces New Funding for Whole Genome Animal Selection

September 2007

CSREES announced November 7 that \$5 million will be available in Fiscal Year 2008 for a 4-year research project to investigate methods of using whole genome enabled animal selection. This research will enable animal breeders to use genetic information to predict what an animal's physical makeup will be and what genes will be passed to the next generation.

To capitalize on this exciting area of science, CSREES and the Agricultural Research Service developed the *Blueprint for USDA Efforts in Agricultural Genomics 2008-2017*. Whole genome enabled animal selection was identified as a high-priority research focus. This program is expected to take advantage of recent advances in genomics and translate these basic discoveries and knowledge to practical applications. CSREES is funding this project under the National Research Initiative's 2008 Request for Applications. Peter Burfening, CSREES national program leader for animal genomics in Competitive Programs Unit, developed this new project and will coordinate the new funding opportunity. Visit the CSREES Newsroom to read USDA Announces New Funding for Whole Genome Animal Selection release.



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This is a young industry....





An animal is born and tagged...



a SNP panel run on the DNA....

DNA from uniquely IDed calf will be run through a 50000 SNP panel of

- unique permanent genetic fingerprint,
- genetic tests for 50,000 markers linked to economically relevant traits, and to

• confirm parentage. Genotype data then stored for future traceback of products derived from that animal, and incorporated into herd and breed EPD calculations.





...and animal is then managed according to genetic potential.

Results are used to make decisions regarding Markets Feeding strategies Health product requirements Breeding decisions — guide selection and replacement choices. Which bulls are producing good calves, no calves ? Which bull should be used with each heifer calf to maximize her offspring's performance



Development of an Integrated Animal Identification and Tracking System for Research and Extension Education



\$80,000 ANR Core Issues Grant





The animal identification does not go with the animal – lost at processing







Sierra Cow-Calf Operation











UC Davis Feedlot Operation





UC Davis Research Data







Los Banos Processing Plant Carcass Data





Psion reader scans EID and carcass data is entered





KI-AIR200 with PSION TEKLOGIX Workabout PRO











Questions ?