

Commercially-available DNA Tests for Beef Cattle

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Marker-Assisted Selection (MAS) is the process of using the results of DNA-marker tests to assist in the selection of individuals to become the parents in the next generation of a genetic improvement program. Selection may be based on test results associated with simple traits such as coat color, horned status, or simply inherited genetic defects. Such traits are determined by the inheritance of specific alleles at known genes and so tests are able to accurately assess whether an animal is a “carrier” (i.e. heterozygous) or will “breed true” (homozygous) for that trait (e.g. red versus black coat color).

MAS also holds great promise for selection based on complex production traits, both those that are in existing genetic evaluation programs, and those for which no genetic merit estimate currently exists. In order of greatest to least degree of benefit, the following categories of traits are likely to benefit the most from marker-assisted selection:

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|-----------------|---|
| Greatest | 1) simply inherited genetic defects, |
| ↓ | 2) carcass quality and palatability attributes, |
| | 3) fertility and reproductive efficiency, |
| | 4) carcass quantity and yield, |
| | 5) milk production and maternal ability, |
| Least | 6) growth traits and birth weight. |

This ranking is due to a combination of considerations including: 1) relative difficulty in collecting performance data, 2) relative magnitude of the heritability and phenotypic variation observed in the traits, 3) amount of performance information available, and 4) when performance data become available in the life cycle.

Marker-assisted selection allows for the selection of specific DNA variations that have been associated with a measurable difference or effect on complex traits. Rarely are DNA markers the actual DNA sequence causing the effect, rather markers are closely situated or “linked” to the causative sequence. Markers therefore flag the location of sequences that have a direct effect on the trait. It is important to realize that each marker associated with complex traits like marbling is associated with only one of the many genes that contribute towards that trait. The presence or absence of the numerous other “unmarked” genes and the production environment will determine whether an animal actually displays the desired phenotype. Genetic tests for complex traits are likely to require hundreds or even thousands of markers to effectively track all of the genes influencing complex traits. This is distinct from the situation for simple traits (e.g. coat color, horned status, lethal recessive mutations) where one or two markers may be sufficient to accurately predict an animal’s phenotype and carrier status.

Recent developments in genotyping technologies and SNP discovery methods have led to the development of panels that allow a single DNA sample to be simultaneously genotyped for tens of thousands of SNPs. It is hoped that cumulatively these markers will be associated with a large proportion of the genetic variation associated with various traits of importance to the beef cattle industry. DNA marker tests should not replace traditional selection based on EPDs. The ultimate goal should be to integrate DNA information into EPDs. The incorporation of DNA test information into carcass trait evaluations by the American Angus Association (www.angus.org/AGI/GenomicEnhancedEPDs.pdf) represents an important milestone towards this ideal. As DNA tests become more comprehensive and encompass a larger number of traits, it will become increasingly important to integrate this information into EPD calculations so that genetic selection tools are delivered to the industry in a form that is familiar to producers.

The commercially-available DNA tests offerings for beef cattle producers change rapidly. The following page lists those that were available in June 2010. This list is kept current at the following website:
<http://animalscience.ucdavis.edu/animalbiotech/Biotechnology/Companies/index.htm>.

- **[AgriGenomics, Inc.](http://www.agrigenomicsinc.com)** (<http://www.agrigenomicsinc.com>)
 Arthrogyrosis Multiplex (AM), Tibial Hemimelia (TH), Pulmonary Hypoplasia with Anasarca (PHA), Black/Red Coat Color (CC), Dilution (DL), Idiopathic Epilepsy (IE), Arthrogyrosis Multiplex (AM) or Curly Calf Syndrome analysis
- **[Biogenetic Services](http://www.biogeneticservices.com)** (<http://www.biogeneticservices.com>)
 Parentage, Freemartin, Coat color, Leptin, Meat quality, BSE resistance, Johne's disease, Bovine Virus Diarrhea (BVD)
- **[GeneSeek](http://www.geneseek.com)** (<http://www.geneseek.com>)
 Arthrogyrosis Multiplex (AM), Parentage, Coat color, Seek-Black, Seek-Tender, Bovine viral diarrhea (BVD-PI), Identity tracking, 50,000 SNP CHIP genotyping
- **[Genetic Visions](http://www.geneticvisions.net)** (<http://www.geneticvisions.net>)
 Coat color, Prolactin (CMP), BLAD, Citrullinemia, DUMPS, Kappa-Casein, Beta-lactoglobulin, Complex Vertebral Malformation (CVM), Calpain 316/530, Freemartin
- **[Igenity](http://us.igenity.com)** (<http://us.igenity.com>)
 Arthrogyrosis Multiplex (AM), Neuropathic Hydrocephalus (NH), Coat Color Dilution (DL), Idiopathic Epilepsy (IE), Osteopetrosis (OS), Pulmonary Hypoplasia with Anasarca (PHA), and Tibial Hemimelia (TH), Parentage, Myostatin, Breed-specific horned/polled, BVD-PI diagnostic test, Igenity Profile Analysis (tenderness, marbling, quality grade, fat thickness, ribeye area, hot carcass weight, yield grade, heifer pregnancy rate, stayability, maternal calving ease, docility, residual feed intake, average daily gain), DoubleBLACK coat color, identity tracking
- **[MMI Genomics](http://www.metamorphixinc.com)** (<http://www.metamorphixinc.com>)
 Arthrogyrosis Multiplex (AM), Neuropathic Hydrocephalus (NH), Osteopetrosis (OS) or "marble bone disease", Parentage, Tru-Marbling™, Tru-Tenderness™, Tru-Back Fat™, Tru-Ribeye™, Tru-ADG™, Tru-Yield Grade™, MMIG Homozygous Black, Polled/horned
- **[Pfizer Animal Genetics \(previously Bovigen\)](http://www.pfizeranimalgenetics.com)** (<http://www.pfizeranimalgenetics.com>)
 Arthrogyrosis Multiplex (AM) or Curly Calf Syndrome analysis, Neuropathic Hydrocephalus (NH), Osteopetrosis (OS), Tibial Hemimelia, Pulmonary Hypoplasia with Anasarca, Idiopathic Epilepsy GeneSTAR® MVP™ (feed efficiency, marbling, tenderness), HD 50K for Angus (calving ease direct, birth weight, weaning weight, average daily gain, dry matter intake, net feed intake, calving ease maternal, mature weight, milking ability, carcass weight, backfat thickness, ribeye area, marbling score, tenderness), GeneSTAR® Elite Tender, GeneSTAR® BLACK, Parentage, Identity tracking
- **[Quantum Genetics](http://www.quantumgenetics.ca)** (<http://www.quantumgenetics.ca>)
 Leptin
- **[Repro Tec Inc.](http://www.reprotec.us)** (<http://www.reprotec.us>)
 Fertility Associated Antigen (FAA)
- **[Veterinary Genetics Laboratory \(UC Davis\)](http://www.vgl.ucdavis.edu)** (<http://www.vgl.ucdavis.edu>)
 Parentage, Freemartin, Coat color, Dexter Cattle: Dexter Dun, Extension (red/black), Bulldog Dwarfism (Chondrodysplasia), Freemartin karyotyping
- **[Viagen](http://www.viagen.com)** (<http://www.viagen.com>)
 Breed identification (AnguSure™)