

CURLY CALF SYNDROME (ARTHROGRYPOSIS MULTIPLEX) TEST AVAILABLE

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A new genetic disorder, dubbed “curly calf syndrome”, has been identified in certain Angus cattle lines and Angus crossbred populations. This genetic defect is the result of the deletion of a small segment of DNA which contains an essential gene. The deletion of this gene results in the absence of a protein required for normal development and when a calf develops *in utero* in the absence of this protein, a “curly calf” results. Four commercial DNA-testing companies are now offering a DNA test for this disorder.



For those unfamiliar with this condition, it is a recessive lethal defect, meaning that a calf has to inherit the genetic defect from both of its parents to be affected. These “curly calves” are stillborn and show symptoms which include a bent or twisted spine, small size and thin appearance, and rigid legs which may be hyper-extended. Animals which are carriers of this defect, meaning they only have one copy of the chromosome with the deletion, appear normal but may have affected calves if bred to another carrier animal.

Figure 1. Appearance of a calf with Arthrogyrosis Multiplex (“curly calf”). Photo used with permission from <http://www.angus.org>.

It is important to note that some of these “curly calf” symptoms can be seen in genetically-normal calves that have been exposed to viruses and other environmental factors. Therefore, the researchers working with this genetic defect have elected to call this condition Arthrogyrosis Multiplex, (or AM for short). Arthrogyrosis means “the permanent fixation of a joint in a contracted position.”

Dr. Jonathan Beever from the University of Illinois and Dr. David Steffen from the University of Nebraska, in collaboration with the American Angus Association, have been investigating AM since September 8, 2008. It appears that the original genetic defect or chromosomal deletion occurred in the maternal grandsire of the widely-used GAR Precision 1680 (AA Registration No. 11520398), and that bull was **Rito 9J9 of B156 7T26**, (AA Registration No. 9682589). Therefore, animals with Rito 9J9 of B156 7T26 in their pedigree would be prime candidates for genetic testing.

The genetic test that Dr. Beever developed identifies an animal as a carrier of the AM mutation (AM \underline{C}) or a non-carrier (AM \underline{E}), meaning an animal that has been determined to be free of the AM mutation. Of course, an AM affected animal (AM \underline{A}) is obvious on the basis of its lethal, “curly calf” appearance. Irrespective of its pedigree, an animal that has been tested

and found to be a non-carrier (AMF) did not inherit the mutation and will not carry or transmit this genetic defect to its progeny. If a cow has an AM calf, it means that the cow is a carrier of the AM mutation and that the sire she was bred to also carries the AM mutation. A listing of the AM carrier-status of Angus sires and cows is available at http://www.angus.org/ccs_info.html.

From a breeding standpoint there are several possible scenarios when considering this mutation. If both parents are carriers (AMC), then there is a one in four chance of having a dead AMA calf, a one in two chance of having a normal-appearing AM carrier (AMC) calf, and a one in four chance of having a normal AM free (AMF) calf.

AMC x AMC = ¼ affected (AMA): ½ normal-appearing carrier (AMC): ¼ AM free (AMF)

If only one parent is a carrier, then all of the offspring will be normal appearing, but half of them will be carriers (AMC).

AMC x AMF = ½ normal-appearing carrier (AMC): ½ AM free calf (AMF)

If you wish to test an animal for AM, you need to collect DNA from the animal and send it to one of the DNA-testing companies offering the AM test (Table 1). Although DNA is present in all tissues of an animal (blood, hair follicles, semen), different DNA-testing companies may prefer you collect a certain tissue type. Additionally, some companies have archived DNA samples from animals that have been previously genotyped for other reasons (e.g. pedigree verification), and in some cases they will be able to use these archived DNA samples for the AM test without the need for further sample collection. Therefore, before you collect a sample from an animal you wish to test for AM, it would be advisable to check with your DNA-test provider to determine whether they have archived DNA available on the animal(s) you wish to test, their preferred sample type for DNA extractions, and whether they have DNA sample collection devices available.

DNA testing company	Website	Cost of AM test	Preferred tissue type
Agrigenomics	www.agrigenomicsinc.com	\$25	Whole blood Semen
Igenity	www.igenity.com	\$26	Whole blood Semen Hair Tissue
MMI genomics	www.metamorphixinc.com	\$24 (1-19 samples) \$22 (20-99 samples) \$20 (100 + samples)	Semen Blood on FTA cards
Pfizer Animal Genetics	www.pfizeranimalgenetics.com	\$29* <small>(*each test earns \$10 credit towards GeneSTAR testing through 6/1/09)</small>	Whole blood Semen Blood on FTA cards Hair sample (> 25 hairs)

Table 1. Commercial DNA-testing companies offering an Arthrogyrosis Multiplex (“curly calf”) test.

Testing recommendations for commercial cow calf operations will vary depending on their specific circumstances. In general, commercial ranches that have used untested Angus sires with Rito 9J9 of B156 7T26 in their pedigree and kept replacement heifers from them, should strongly consider any new bull purchases or semen be tested AMF. To rapidly eliminate this genetic defect from the herd, replacement heifers should ideally only be kept from bulls that have been tested AMF. Note that any calf produced by a mating between a tested AMF bull and a tested AMF cow, will be AMF, irrespective of its pedigree.

If you have some cows that have AM carriers in their pedigree and you have not tested their carrier status, the safest option would be to breed them to tested AM free (AMF) bulls. This eliminates the risk of having a dead calf, but it does not eliminate the risk of producing more carrier animals. Only genetic testing can definitively rule out whether an animal with carriers in its pedigree is AM free (AMF). It is also important to realize that the AM defect may be present in other breeds besides Angus because of crossbreeding.

Naturally-occurring recessive genetic defects are common in all species, and only become evident when certain lines of cattle are used very heavily, such that both cows and bulls have common ancestors in their pedigree, thereby allowing a rare genetic defect to become homozygous in their offspring. The widespread use of the superior carcass-trait bull Precision 1680, an AM carrier (AMC), increased the probability of this bull showing up on both sides of many Angus pedigrees, and this uncovered the presence of the recessive lethal mutation that results in “curly calf” syndrome.

The development of a commercial DNA test for this genetic defect occurred very quickly. A period of only 4 months elapsed between the time when Dr. David Steffen first sent a notice detailing the need to obtain pedigree information and DNA from cases of “curly calf syndrome” to the Angus Association in late August 2008, and the announcement of the availability of commercial DNA tests in December 2008. The development of this test was made possible by the availability of the bovine genome sequence, and represents one of the most compelling examples of the power and utility of this sequence information for the cattle industry. In the absence of a DNA test, there would be no way to determine the AM-status of animals with affected pedigrees, and in the process of proactively eliminating potential carriers, many AMF animals would have been needlessly culled.

If you are interested in finding out more about this topic, Dr. Jonathan Beever from the University of Illinois, the developer of the AM test, will be speaking on Saturday May 2nd, 2009 at the Beef Improvement Federation (BIF) research symposium in Sacramento. This two-day meeting includes presentations from national and international experts in beef cattle genetics and breeding, and offers California beef cattle producers a unique opportunity to attend this roving national meeting in their own state.

The BIF 2009 conference will be held at the Sheraton Grand Hotel April 30 – May 3, 2009 in Sacramento, California. BIF 2009 is being hosted by the California Beef Cattle Improvement Association (CBCIA) and the California Cattlemen’s Association. The registration and hotel information site for this meeting is now open at www.calcattlemen.org/bif2009.html. You may also contact the organizing committee co-chairs Dr. Alison Van Eenennaam at (530) 752-7942; alvane@ucdavis.edu, or Terry Jochim at (916) 709-2159; dustytrl@cattlemen.net for additional information and conference details.