Arthrogryposis Multiplex: Q&A

by ***American Angus Association***

On Saturday, Nov. 15, 2008, the Board of Directors of the Association, through a series of unanimous votes, adopted a new policy and related set of rules governing the handling of genetic defects within the breed. These actions concluded an eight-week examination of the Association's prior policy and rules dealing with the subjects of genetic defects generally and arthrogryposis multiplex (AM) in particular.

At its November meeting, the Board:

- ►Adopted a new policy related to its handling of genetic defects and amended Rules 300 to 307. (To see the amended rules, visit *www.angus.org/PolicyandRelatedRules.pdf* or see the *Breeder's Reference Guide* scheduled to be inserted in the March *Angus Journal.*)
- ►Adopted a specific policy relating to the registration status of potential and known carriers of arthrogryposis multiplex (AM). (For the policy, visit *www.angus.org/AMPolicy.pdf* or see "AM: Registration Policy" on page 44).
- ►Amended Rule 103(d) to recognize AM and prohibit the registration of affected animals (Note: This amendment does not apply to carriers of a genetic defect but instead to actual animals physically afflicted by the recognized abnormalities. For the rule, refer to *www.angus.org/NewRule103d.pdf* or the *Breeder's Reference Guide.*)
- ►Rescinded Rule 806, relating to the showing of cattle that are carriers of a recognized genetic defect. (Refer to the 2008 *Breeder's Reference Guide* inserted in the March 2008 *Angus Journal* for a copy of the rule, which has been rescinded.)
- ►The Association's rule relating to "genetic factors," as opposed to genetic defects, remains unchanged and is now set forth as Rule 350 GF. (For the rule refer to *www.angus.org/Rule350GF.pdf* or the *Breeder's Reference Guide.*)

Please take note that both the new policies and rules emphasize the Association's ability to convey timely and accurate information through its web site (*www.angus.org*). Members should check that web site regularly to access the names and registration numbers of carrier animals, as well as animals tested free of the genetic defect. A printed listing of such animals will be made available to any requesting member without charge, but the most up-to-date version of such listings is available at the Association web site.

►Note the contracted or extended limbs, curved spine and "thin" appearance of calves affected by AM.

Editor's Note: *The above notice was posted to the American Angus Association web site,* www.angus.org, *Nov. 20, 2008. The Q&A was posted Nov. 25.*

Commonly asked questions

The following summary was developed to respond to questions commonly asked by American Angus Association members. Both the questions and the answers are based on the operating assumption that AM is a genetic defect with a simple recessive pattern of inheritance and that the test developed by Jon Beever of the University of Illinois and licensed for use by multiple laboratories (see page 42) can determine whether an animal is a carrier of the mutation or free of it.

What is an AM calf?

Calves are born dead or die shortly after birth. The spine and legs appear crooked or twisted and the joints of the legs are often fixed in position. Front legs are contracted and rear limbs may be contracted or extended. Calves are small and appear thin due to limited muscle development. There may be a cleft affecting the nose or palate. (see photos).

What is an AM carrier?

For purposes of this response, an AM carrier is an Angus or Angus-cross cow, heifer, bull, or steer that carries the recessive AM mutation in its DNA.

Why are carriers of AM important?

Carriers of AM used in breeding programs (registered or commercial) are responsible for propagating the recessive mutation within the cattle population.

What does an AM carrier look like?

An AM carrier looks perfectly normal; there is nothing in the way the animal looks (its phenotype) that indicates that the animal is a carrier of the AM mutation.

If a cow has an AM calf, what does that mean?

If a cow has an AM calf, and if it is the cow's natural calf, it means that the cow is a carrier of the AM mutation and the sire of the calf is also an AM carrier.

If a recipient cow has an AM calf, what does that mean?

If a recipient cow has an AM calf, it means only that both the donor cow and the sire of the calf are carriers of the AM mutation. It doesn't tell you anything about the AM carrier status of the recipient cow.

If a bull sires an AM calf, what does that mean?

If a bull sires an AM calf, it means that the bull is a carrier of the AM mutation and the dam of the calf is also an AM carrier.

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I have never had an AM calf. Does that mean my cows are non-carriers?

Not necessarily.

What is the risk of having an AM calf if I breed an AM carrier cow to an AM carrier bull?

Every time you breed a carrier to a carrier, there is:

- ►a 25% risk of having a dead AM calf;
- ►a 50% risk of having an otherwise normal-looking calf that carries the AM mutation;
- ►a 25% chance that you will have a non-carrier calf.

AM potential carrier report

AAA Login users can access an interactive tool to generate a report of owned animals and their arthrogryposis multiplex (AM) status based on the AM test results received to date. From the AAA Login menu, go to the "Interactive" section and click on "AM Potential Carrier Report." If you are not a current AAA Login user, you can sign up to create an online profile at *www.angusonline.com*.

If I breed an AM carrier cow to an AM carrier bull and have three live calves, will the fourth calf have AM?

The risk is the same every time you breed a carrier to a carrier. There is always a 25% risk of having a dead AM calf, a 50% risk of having a carrier calf, and a 25% chance of having a non-carrier calf.

If I breed an AM carrier cow to a non-carrier bull, what is the chance of having an AM calf?

Zero. You will never have an AM calf if you breed a carrier cow to a non-carrier bull.*

If I breed an AM carrier cow to a non-carrier bull, what is the risk of having a carrier calf?

Every time you breed a carrier cow to a non-carrier bull there is:

- ►a 50% risk of having a normal-looking calf that carries the AM mutation; and
- ►a 50% chance you will have a non-carrier calf.

If I breed a non-carrier cow to a carrier bull, does that change the risks?

No. The risks do not change. A carrier mated to a non-carrier always produces a 50% chance of a non-carrier calf and 50% risk of a carrier calf.

I have many cows that have AM carriers in their pedigrees. Until they are tested, I won't know if they are AM carriers or non-carriers. How should I breed them?

The goal would be to use bulls without any AM genetics in their pedigree. If you breed your AM-influenced cows to unrelated or AM-tested free bulls, your risk of having an AM calf is eliminated.

What do I do with confirmed non-carrier females in my herd?

If the females are tested non-carriers and they are bred to non-carrier bulls, they will never produce affected AM calves or carriers. These non-carrier females can be used throughout your breeding program with no risk of propagating the AM mutation.

What do I do with confirmed female carriers in my herd?

You have several options:

- ►If you have a cow that carries the AM mutation and you want to produce calves from her, you must make a commitment to test all offspring retained for breeding;
- ►If you have both a registered and a commercial herd, retain your carrier cows in the commercial herd, breed to a non-carrier bull, and test any calves retained for breeding purposes;
- ►If you always breed your carrier cows to a non-carrier bull, you will never have an AM calf. Then, treat the resulting calves as market animals, not as breeding stock.
- ►Use your AM carrier cows as ET recipients. As a recipient female, she has no genetic effect on the embryo calf she raises. AJ

**These answers exclude the possibility of a spontaneous mutation occurring.*

Definitions

AM carrier: Any animal that carries the recessive AM mutation in its DNA.

AM non-carrier: Any animal that has been determined to be free of and without the AM mutation.

AM calf: An affected calf born dead (or that dies shortly after birth) with a spine that is bent or twisted, that appears small and thin and has legs that are often rigid and may be hyper-extended.

A video is available of Jon Beever's presentation given during the Angus Education Center conducted in conjunction with the Association's 125th Annual Meeting in Louisville, Ky. To access the presentation, visit *www.angus.org/ccs_info.html*.

Association-authorized labs for AM testing

Below are the labs authorized as of Jan. 14, 2009, for AM testing by the American Angus Association. Consult the respective web sites for information on preferred sample types, sample submission forms, pricing information and complete instructions on how and where to submit samples for testing. In choosing a lab, members of the Association are urged to read and carefully consider any language on a given lab's submission form (for the AM test) or on its accompanying "Terms and Conditions" that relates to any lab's alternative use of the DNA samples being submitted. For updates to this list, visit *www.angus.org/AMLabs.html*.

AgriGenomics
2399 N. 1000 E. Rd.
Mansfield, IL 61854
217-762-9808

GeneSeek
4665 Innovation Dr.
Suite 120
Lincoln NE 68521
402-435-0665
www.geneseek.com

Igenity
4701 Innovation Dr.
CB 101
Lincoln, NE 68521
1-877-IGENITY
1-877-443-6489
www.igenity.com

MMI Genomics
1756 Picasso Ave.
Davis, CA 95618
1-800-311-8808 ext 3016
www.mmigenomics.com/Curly_Calf.html

Pfizer Animal Genetics
250 Plauche St.
Harahan, LA 70123
1-877-BEEF DNA
1-877-233-3362
www.pfizeranimalgenetics.com

AM: Registration Policy

Policy of the American Angus Association relating to the registration status of potential and known carriers of arthrogryposis multiplex (AM).

by ***American Angus Association***

On Nov. 15, 2008, the Board of Directors of the American Angus Association amended its policy and rules relating to abnormalities and genetic defects. Among other things, this amendment recognized, for the first time, a genetic defect known as arthrogryposis multiplex (AM), an abnormality originally referred to by veterinarian David Steffen of the University of Nebraska, on Sept. 5, 2008, as curly calf syndrome.

Pursuant to Rule 307, approved on the same date, the Board was authorized to "develop, establish and implement a specific policy" in those situations in which there is a reliable test, approved by the Association that can conclusively identify and separate carriers of recognized genetic mutations from animals free of it.

The following is a specific policy approved by the Board. Its procedures became effective Dec. 31, 2008, the date the Association provided notice on its web site that it had approved one or more laboratories to process test results that can conclusively identify and separate carriers of the AM mutation from animals free of it.

This policy and these procedures apply to the AM mutation and that mutation only.

The impacted genetics

On Sept. 16, 2008, the Association posted an "important update" on the status of AM on its web site in which Jon Beever of the University of Illinois tentatively concluded that AM appeared most likely to be caused by a simple recessive gene, traced at that time from a most recent common ancestor, GAR Precision 1680, Registration No. 11520398. However, Beever emphasized (as did the Association), that his tentative conclusion did not preclude other ancestors of this bull, on either the sire or dam side, from potentially being identified as a carrier at a later time.

Over the course of the weeks that followed, Beever was ultimately able to identify the mutation that he believed was responsible for causing AM. On Nov. 3, 2008, he reported to the Association (in an update that was posted on the Association's web site) that he had "developed an accurate DNA-based diagnostic test that can be used to assess an individual's status for AM." In that same update, he also revealed that as a part of that test's development, he had tested samples of 736 registered Angus AI (artificial insemination) sires, the results of which he believed would be beneficial to release to the industry. The results were posted on the Association's web site that day.

As he had cautioned readers on Sept. 16, 2008, an ancestor of 1680 — his maternal grandsire, Rito 9J9 of B156 7T26, Registration No. 9682589 — has now been identified as a carrier of AM. Accordingly, for purposes of the procedures that follow, the phrase "the impacted genetics" currently refers to all animals with Rito 9J9 of B156 7T26, Registration No. 9682589, in their pedigrees. This current conclusion does not preclude other ancestors of this bull from potentially being identified as carriers at a later time.

Procedures

The following procedures shall be followed in connection with the registration status of potential and known carriers of AM (formerly referred to as curly calf syndrome):

I. Status of currently registered females and bulls

1. As used herein, the word "currently" in the phrase "currently registered" shall mean that date on which laboratories approved by the Association shall begin to provide a commercial DNA test for the AM mutation to the membership (Dec. 31, 2008).

2. All currently registered females and bulls with the impacted genetics in their pedigrees shall remain registered. In other words, their registrations will not be revoked, cancelled or suspended.

3. All currently registered females and bulls with the impacted genetics in their pedigrees that are tested and determined to be carriers of the AM mutation shall remain registered.

II. Resulting progeny of currently registered AM-carrier females and bulls

1. All resulting calves of currently registered AM carrier females and bulls, born on or before Dec. 31, 2009, must be DNA-tested for the AM mutation at a laboratory authorized by the Association in order to be eligible for registration. The results of such a test (reflecting whether the animal tested is a carrier of the mutation or free of it) shall be denoted on the animal's registration and performance certificates in the manner prescribed below.

2. All resulting calves of currently registered AM-carrier females and bulls born on or after Jan. 1, 2010, must be DNA-tested for the AM mutation and found to be free of that mutation in order to be eligible for registration.

III. Currently registered AI sires determined to be carriers of the AM gene mutation

1. All calves sired artificially by non-owned bulls (calves that would require an AI service certificate) shall be ineligible for registration if conceived after sixty (60) days following the date on which that sire is listed on the Association's web site as a carrier of the AM mutation. Calves resulting from embryos conceived artificially by non-owned bulls with embryo removal dates after 67 days following the date on which that sire is listed on the Association's web site as carriers of the AM mutation shall be ineligible for registration.

2. The Association will publish the names and registration numbers of such sires on its web site only upon receipt of a test determination from an approved laboratory.

IV. Registration of clones with impacted genetics

Clones of any animal determined to be a carrier of the AM mutation shall be ineligible for registration. Clones of untested animals with the impacted genetics shall also be ineligible for registration.

V. Testing of animals

1. Testing to determine whether an animal is a carrier of the AM mutation or is free of it shall be conducted at those laboratories approved by the Association.

2. The results of such testing shall be provided to the Association and the submitting member as soon as practicable after the test results are available.

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VI. Publication of test results by the Association

Upon receipt of a test result from an approved laboratory that determines whether an animal is a carrier of the AM mutation or is free of it, the Association shall list the name, registration number and test result of each such animal on its web site.

The Association shall also maintain an updated list of each animal determined to be a carrier as well as those who have tested free of such defect. Upon request, the Director of Member Services shall provide such a list at no cost to the requesting member.

VII. Right to request a second DNA test

In those instances in which an animal previously registered or seeking registration is tested and determined to be a carrier of the AM mutation (and is identified as such on the Association's web site), the member owner of record may request that an approved laboratory conduct a second DNA test on a sample from such animal.

In order to process a request for a second test, the member owner of record must provide materials or samples sufficient to permit the laboratory to verify the parentage of the animal in question.

VIII. Notations on registration and performance pedigree certificates

1. Upon receipt of a test result from an approved laboratory, the Association shall place or electronically display the letter designation "AMF" on the registration and performance pedigree certificates of any animal that has been determined by such a test to be free of the AM mutation. AMF shall mean "Arthrogryposis Multiplex–Free," or that an animal is free of the mutation.

2. Upon receipt of a test result from an approved laboratory, the Association shall place or electronically display the letter designation "AMC" on the registration and performance pedigree certificates of any animal that has been determined by such test to be a carrier of the AM mutation. AMC shall mean "Arthrogryposis Multiplex–Carrier," or that the animal is a carrier of the AM mutation.

3. Six months following the availability of a commercial test for the AM mutation (at commercial laboratories approved by the Association), the Association shall place or electronically display the following notation on the registration and performance pedigree certificates of all registered animals that descend from an animal determined to be a carrier of the AM mutation, unless an intervening AMF status eliminates all genetic ties to a known carrier ancestor:

This animal has one or more ancestors known to carry a mutation that can result in calves with a genetic defect known as arthrogryposis multiplex (AM). The American Angus Association recommends approved DNA testing to confirm the absence or presence of the mutation.

Such notification will remain in place until the Association receives an official determination from an approved laboratory that the particular animal tested is a carrier of the AM mutation or is free of it, in which case its certificates will be denoted pursuant to paragraph VIII. 1 and 2 of these procedures.

AJ

Association Note: *These procedures apply only to arthrogryposis multiplex.*

PERSPECTIVES

Editor's Mailbox

►**Readers' viewpoints** submitted to our staff

Well-done

I wanted to share with you, Crystal Albers did an excellent job of conveying a powerful message with the "Scars of Strength" article in your October issue. I had an opportunity to meet Kristi when she was in her local Extension office in September, and she proudly told me of her dedication to tell the story of farm safety through her experiences. She is a delightful young lady with a spirit of determination.

— Alan Ladd, Lewis, Iowa

I just finished reading the "Scars of Strength" article about Kristi Ruth written by Crystal Albers. It was indeed a very moving story. The horrible details were woven into a very touching story. The horrors of Kristi's accident became very realistic as the story brought tears to my eyes — tears of pain, tears of hope, tears of encouragement for Kristi, tears of support for a very determined young lady! I wish her nothing but the best!

It has been my privilege to get to know Kristi. She has served as a representative on the Southwest Area 4-H Youth Council where I serve as one of the advisors. Her determination for success and active involvement is obvious there, too. She would be insulted if we offered her too much help! What an outstanding example for all youth!

Thank you and Ms. Albers for sharing her story.

— Ray Reynolds, Creston, Iowa


Scars of Strength

Angus Productions Inc. should be commended on capturing and sharing the Kristi Ruth story in "Scars of Strength" published in the *Angus Journal.* It is a testament to the courageous character of the people who produce our country's food and work in the most dangerous industry in the United States. The story also shows how quickly a tragic injury can alter a life, one's family, and their community. Agriculture has many hazards that are not often recognized. I believe your readers will benefit from this story by gaining a better understanding about agricultural hazards and the resulting devastation.

The depth and detail included by Crystal Albers was refreshing. She captured all elements of the story and made it informative. It is easy to picture others reading this story and realizing this could have been them instead of believing it would never happen to them. This is a difficult point to convey, and Ms. Albers did it successfully.

Thanks for increasing the awareness.

— Charles Schwab, Ames, Iowa

AJ