



Curly Calf Syndrome - Information for the cattle producer

By Don Nicol

Introduction

The recent discovery of Curly Calf Syndrome (CCS); technical name Arthrogryposis Multiplex (AM), in the Angus breed is a serious situation that Angus breeders, stud and commercial, and Angus Australia are working hard to resolve. Breeders should not panic nor take drastic actions because the situation is one that is quite manageable in most cases and one that can be resolved over time.

By taking time to study the way the disease is inherited and also taking into consideration that a DNA diagnostic test is not far off commercially, a practical solution can be developed for your Angus or Angus-cross herd.

Genetic defects

Genetic disorders or defects are a reality in all breeds and the Angus breed in the past had a very successful campaign to deal with an inherited disease called mannosidosis and similar success can be expected in this case.

The purpose of this article is to provide information on the way the disorder is inherited and implications for the Angus producer in their breeding programs.

Simply-inherited defect

Although, yet to be independently validated, there is an extremely high probability that AM is a simply inherited recessive, lethal genetic defect. This means that a single pair of genes controls the condition. In such case it requires both recessive genes to be present before the actual condition is manifested; in which case you get a misshapen calf (so-called curly calf), dead at birth.

Mannosidosis and Fawn Calf Syndrome similarly are diseases that are simply inherited recessives but in their case it is not lethal at birth.

'Carriers' of the defect

A very popular bull in the breed called GAR Precision 1680 and his even more popular son, CA Future Direction 5321 have been tested to be carriers of the AM condition. A list of related Australian AI sires together with their test results are available on the AA website or available directly from Angus Australia on request.

By saying they are carriers, it means that they have one copy of the lethal gene and one copy of the normal form of the gene, that they in turn can pass to a random half of their progeny. The abovementioned bulls or other tested carriers would have to be present on both sides of the pedigree (on the sire's and dam's side) for the lethal condition to be present.

When a carrier bull is mated to a carrier female there is a 25% chance on average that the calf will have two copies of the lethal gene and be born dead. However there is also a 50% chance that the matings will produce carriers and **importantly** a 25% chance that the progeny produced will have two normal genes and consequently will never pass on the lethal gene (see Figure 1 for illustration).

By mating a carrier bull to non-carrier females then the actual AM condition will not be expressed – all calves will appear like normal calves, but half these resultant calves (50%) will be carriers (see Figure 2).

Implications for your Angus breeding program once you can test bulls and where you are retaining replacement heifers

- A DNA test will soon be commercially available. Already a number of bulls have been tested and AA will maintain lists of carrier bulls and cows. If a carrier animal is not evident in the registered pedigree of an animal then the risks of the animal in question being a carrier are extremely small.
- Do not breed close or inbreed if carriers are in the pedigrees of your herd. Remember if descendants of carriers are not mated together then the condition will not result from such matings.
- Commercial producers using Angus bulls in a crossbreeding program have little risk of getting an AM calf even if carrier Angus bulls have been used in the past.
- Angus bull breeders that potentially have carriers in the matings they have already made will be able to test animals soon after birth to determine if they are carriers. DNA test lists will be available as soon as the test becomes available but if there are no carriers in the pedigrees, tests will not normally be necessary.
- Remember, in the absence of a test result the only way to have dead calves from the condition is to have a carrier in the pedigree of the sire **and** the dam.
- Lastly, all breeds have genetic defects and more will be discovered in future for sure. With today's DNA tools these genetic defects can be managed!

Review of potential outcomes from matings

The potential outcomes of various types of matings are shown below. Two pairs of genes are involved in each example giving us four possible outcomes in the squares.

Inheritance of a simple recessive genetic defect

If **N** = Normal calf gene and **n** = curly calf gene then
NN = normal calf and **Nn** = a carrier calf and **nn** = a curly calf

The genotype of possible calves are as follows:

Figure 1: Mating a carrier bull to a carrier cow

	Carrier Bull Nn		
Cow is carrier Nn	NN normal	Nn carrier	Average outcomes: 25% Normal calves (NN) 50% Carrier calves (Nn) 25% Curly calf (nn)
	Nn carrier	nn lethal	

Figure 2: Mating a carrier bull (Nn) to a normal cow (NN)

	Nn carrier bull		
Normal cow NN	NN normal	Nn carrier	Average outcomes: 50% NN = normal 50% Nn carriers
	Nn carrier	NN normal	

New DNA test for AM: How are the results expressed?

The DNA test identifies animals as having one of the three possible genotypes. If an animal is normal i.e. doesn't have a AM gene, then it is named **AM-FREE (AMF)** indicating they have been tested for the gene and have been found to be free of this genetic condition. AMF animals will not transmit the defect gene to any of their progeny

If the test shows the animal has one normal form of the gene and another defective form then they are labelled as **AM-Carrier (AMC)**

As you would imagine affected calves are rarely tested, if you did they would have two copies of the defective form of the gene and called **AM-Affected (AMA)**.

Quick reference:

Mating outcomes for a recessive genetic defect using test results.

The result of different mating with normal and carrier bulls and females is shown in terms of expected average progeny percentages¹ below:

Sire is	Dam is	Percentages of progeny expected to be		
		AMF	AMC	AMA
AMF	AMF	100%		
AMF	AMC	50%	50%	
AMC	AMF	50%	50%	
AMC	AMC	25%	50%	25%

¹ These average percentages are calculated based on large numbers. Actual percentages will vary based on small samples.