

Epigenetics And How They Might Be Changing The Shorthorn Breed

Farm Update:

We have had the coldest winter in over 10 years with several snow events. The cold/wet weather has continued through the first half of spring causing significant problems for the cows, calves, and me. The pasture growth is approximately a month behind normal. Our cows finally went out on pasture the latest they ever have (mid-April).

Several cows have already calved and we are very impressed with many of the new calves we have sired by some of the great Heritage Shorthorn bulls born in the 60's and 70's (Boa Kae Royal Oak, Mandalong Super Elephant, Four Point Major, Kenmar President 26A and Spiro. As spring progresses we expect the arrival of several additional calves that will help increase the diversity of today's Heritage Shorthorns.

Shorthorn Bulletin Update:

The Shorthorn Bulletin has been published for 8 years and there have been many changes in both the Shorthorn and Cattle Industries over that time frame. As a result I will be slowly updating some of the older Shorthorn Bulletins to reflect some of these changes. As I complete updating a particular SB issue an announcement of the update will be made in the following issue of the Shorthorn Bulletin so that readers of the Shorthorn Bulletin can reread the updated issue if they are interested.

Shorthorn Connections:

My ongoing interest in the Shorthorn breed can be broken into three parts: historical, breed preservation, and current breed changes. Over time I have been able to amass a large collection of Shorthorn historical books, magazines, and other documents that has allowed me to become fairly well versed in Shorthorn history. My pursuit of older Heritage Shorthorn bull semen has provided a dynamic basis for the Whispering Hills Farm herd, while reviving the classic genetics the Shorthorn breed was founded on. Recently the movement by both the American Shorthorn Association and the American Milking Shorthorn Society to emphasize shows/showing, especially with Junior members, has resulted in more overt and covert changes to the Shorthorn cattle breed increasing my concern that the original Shorthorn paradigm is being destroyed. Overt changes include: cross breeding, upgrading pedigrees, and breed type changes by judges. These are all obvious transformational changes that can be well documented. A further concern is the covert changes that are occurring that are causing additional long term shifts in the Shorthorn genetic base that most people are not recognizing because they are intertwined with the nature of Epigenetics and Fetal Programming.

What are Epigenetics:

Epigenetics is the study of different behaviors and environments that affect the expression & heritability of genes which can not only affect a particular animal but potentially also affect subsequent generations. Epigenetic research has greatly expanded our knowledge of subtle changes that activate and deactivate genes in the developing life form. DNA molecular sequences are not changed, but instead genes are either turned on or turned off to affect various traits. How that happens is really what the scientific field of epigenetics is all about.

Why is this important to know? Because efforts made to improve a species, in our case Shorthorns, through selective use of EPDs, genomics, and phenotype may be inadvertently negated by the turning on or off of certain important genes that may have been beneficial to the individual and the breed.

What is Fetal Programming:

If Epigenetics is the study of what affects the turning on and off of genes in the developing fetuses then Fetal Programming is taking accidental or intentional actions that will result in lifelong positive or negative outcomes by causing epigenetic changes in the developing fetus. For example it is a well known that stressful or alarming events during a cow's pregnancy will increase the chances that her offspring will not be a calm calf. Thus the demeanor of the dam (fetal programming) will cause a change in what personality genes are turned on or off in her offspring during gestation (epigenetic affect). Poor nutrition or starvation in the dam during gestation can trigger permanent stunting of her calf's growth, while optimal dietary conditions will maximize positive traits in the calf—fetal programming maximizing positive epigenetic affects.

What Overt Changes Have Occurred In Shorthorns:

Like many historical breeds of livestock Shorthorns are a landrace breed. They were developed to be productive in a particular environment and effectuate the production of milk and beef in a small farm setting (Dual Purpose family cow). When the Shorthorn breed association in the USA was split a new direction was taken with more specialized milk or beef animals. This was not the result of Epigenetics or Fetal Programming. It was simple genetic selection. Over the course of time genetic selection has dramatically changed Shorthorns as show judges, promoters, breed associations, and cross breeding have produced a “ping pong affect” where Shorthorns have gone from big to little to big to little all the while being proclaimed as the best the breed has ever seen. If anyone believes that then they are either naive, misrepresenting facts, or are participants in this charade. True 100% Shorthorns are making a comeback as the overt negative changes to the Shorthorn breed are becoming obvious to even the casual observer.

What Covert Changes Are Occurring In Shorthorns:

To me a more concerning turn of events is the “under the radar” (Epigenetic) changes that are happening in the Shorthorn breed that no one is taking into account. Subtle changes ultimately change the character and traits of any breed of livestock but are occurring more rapidly in both Milking and Beef Shorthorns because of production systems, artificial breeding, showing, lack of health considerations, and embryo transfers. Fetal Programming is happening as a result of all of these systematic changes in Shorthorns. These changes can each have a detrimental affect on the Shorthorn breed. The rapid movement toward Confined Animal Feeding Operations (CAFO) has become the dominant production system in cattle. The result is that genes that have been instrumental in the conversion of grass to milk or beef may be turned off in the fetus because the dam is now consuming a specialized mixed diet that is producing fetal nutrients that are affecting what genes are being activated. This is particularly relevant in show animals, which are now dominant in both milking and beef Shorthorns, because they are being fed a “pushed” diet with artificial products while being overfed to project what is called “show condition”. To believe that this does not result in negative fetal programming in pregnant animals is naive. As we learn more about how fertilization occurs, and the effect of bull semen production, evidence is accumulating that AI may be subtly changing

reproductive genes because certain types of sperm may be selected through the freezing process which may activate genes that are changing the genome of the future fetus. Immune status of the dam, along with overall health, may be programming the fetus to be either more resistant or more vulnerable to disease. One technology that may be having the greatest epigenetic affect on the Shorthorn breed is embryo transfer (conventional or IVF) into recipient cows. Most breeders using ETs to produce offspring are not giving much thought to the recipient cow when in actuality that may be the most important factor in maximizing the positive genetic potential of the calf. Haphazardly using any cow, not taking into account her age, health, condition, breed, temperament, and diet may be having a substantial negative impact via fetal programming and causing dramatic epigenetic changes. In reality selecting a quality (healthy, even tempered, consuming a well balanced diet) Shorthorn cow as the recipient for any Shorthorn embryo is the best route to success for producing an outstanding calf. (The next SB will have much more information on embryo production in Shorthorns.) Many other conditions that we may yet not be aware of could trigger negative or positive fetal programming as the science of epigenetics is still in its infancy. The best advice is to optimally manage carefully chosen recipient cows throughout their pregnancies if the goal is to maximize the positive genetic potential of their offspring.

What Does All This Mean For Shorthorns:

Epigenetic changes to the Shorthorn breed, along with other breeds of livestock, are happening through fetal programming that we do not completely understand. The fact Shorthorns are now primarily show animals with no relation to their landrace roots is resulting in both overt and covert changes to the breed that are not necessarily positive. Those looking to breed Shorthorns should carefully consider their objectives realizing today's Shorthorns are a "different animal" through selective breeding and management changes that have produced both genetic and epigenetic changes to the breed that make them different from the Shorthorns of yesteryear. If a potential Shorthorn breeder is interested in the classic type of Shorthorn then consideration should be made to breed Heritage Shorthorns and leave the show cattle behind. It has been said "It's not nice to fool mother nature". Modern Shorthorn production is trying to do just that.

Future Topic: A Primer For IVF Embryo Production In Shorthorns