Bull Reproductive Health Fact Sheet

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Bulls are common on many beef operations. It is estimated that 90% of beef producers utilize a bull for breeding purposes. Therefore, the reproductive efficiency of the operation is dependent, not only on the reproductive efficiency of the dam, but also the sire. In this fact sheet we are going to address bull reproductive health.

You need to first understand the various parts of the bull reproductive system and what their function is to completely understand bull reproductive health.

Basic Components of male reproductive System:

- Spermatic Cord
- Scrotum
- Testis
- Excurrent duct system
- Accessory sex glands
- Penis and muscles for protrusion, erection and ejaculation

Spermatic Cord: The primary function is to connect the testis to the body. The spermatic cord also houses the cremaster muscle and the pampiniform plexus. The cremaster muscle is the primary muscle supporting the testis and is responsible for facilitating blood flow to the testis. The cremaster muscle is not responsible for elevating the testis during cold temperatures. Also located in the spermatic cord is the pampiniform plexus. This structure is necessary to cool the blood entering the testis. On average the blood within the testis is 4 - 6^{o}C cooler than body temperature. The pampiniform plexus is a venous network that acts to cool the blood entering the testis. Heat from the warm (39^{o}C) arterial blood from the body is transferred to the cooler (33^{o}C) venous blood leaving the surface of the testis. The venous blood has been cooled by direct heat loss from the testicular veins through the skin of the scrotum.

Scrotum: The protective sac that surrounds the testis. The scrotum is heavily populated by sweat glands and is responsible for cooling the testis through evaporative heat transfer. The scrotum is responsible for raising and lowering the testes in response to temperature. There is a correlation between scrotal circumference and sperm production. Therefore, animals with larger scrotal circumference have higher sperm production. Scrotal circumference has a medium to high heritability so it can be selected for to increase male fertility. Scrotal circumference is also positively related to the fertility of his daughters. Heifers from bulls with larger than average scrotal circumference tend to reach puberty earlier than those from bulls with smaller scrotal circumference (Evans et al. 1999). Accumulation of fat within the testis can negatively affect the animal's ability to cool the testes. Fat pad accumulation interferes with the function of the pampinifrom plexus and the scrotum. Scar tissue on the scrotum will also hinder the cooling ability of the scrotum. "Short Scrotumed" Bulls or bulls with small scrotums will also have an issue with cooling because the testis cannot hang away from the body far enough to get cool.

Testis: Paired organ that varies considerably in size and shape among species. The testis is the main reproductive organ of the male and is responsible for producing spermatozoa, hormones and proteins, and fluids. The fluids produced by the testis are necessary to move spermatozoa through the testis to the excurrent duct system, but are not a major component of the ejaculate.

Each Sertoli cell hosts a maximum number of developing germ cells. Therefore, the more Sertoli cells you have the more germ cells you will have.

Males produce sperm constantly and uniformly throughout their lifespan. It takes 61 days for the bull to complete spermatogenesis. Spermatogenesis is broken into a series of cellular generations. With "graduation" to each successive generation the germ cells become more mature, until they are eventually released into the excurrent duct system. It takes 13.5 days to complete one generation.

Testicular Cells:

Leydig Cells – Produce Testosterone

Sertoli Cells – "Governors" of spermatogenesis

Germ Cells – Become sperm

There is a 2-4 week delay before the effects of deleterious events such as heat stress, shipping, fever, or exposure to certain toxins can be observed by monitoring changes in the ejaculate characteristics.

6-12 weeks are required before restoration of normal spermatogenesis can be accomplished after these events.

Effect of Temperature on Spermatogenesis:

Hot Temperature:

After 8 hours or more of heat exposure motility is reduced significantly.

Excessive heat is thought to cause DNA damage in sperm, and eggs fertilized by these sperm have low rates of survival.

Cold Temperature:

Causes a decrease in spermatogenesis

Males can obtain frost bite on the scrotum, which interferes with cooling during the summer months.

Excurrent Duct System: Allows for final maturation, storage, and delivery of spermatozoa to the pelvic urethra. Acquisition of motility and potential fertility require final maturation.

Excurrent Duct System consists of:

- Efferent Ducts – Convey newly formed spermatozoa and fluid into the epididymal duct
- Epididymal duct – Provides the environment for final maturation of spermatozoa
- Ductus deferens – Connects the epididymal duct to the pelvic urethra

Final maturation of the sperm occurs in the epididymal duct (Figure 1). It takes two days to transport spermatozoa from the head to the body and also two days to transport them from the body to the tail. Epididymal transit time is not altered by sexual excitation. However, the number of sperm in the tail can be altered by the frequency of ejaculation.

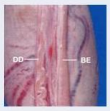
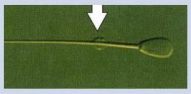
Location	Spermatozoal Characteristic	Picture
Head 	• Not motile • Not fertile • Proximal cytoplasmic droplet	
Body 	• Some expression of motility after dilution • Some expression of fertility • Translocating cytoplasmic droplet • Can bind to oocytes	
Tail 	• Expression of normal motility after dilution • Fertile potential • Distal Droplet • Can bind to oocytes	

Figure 1: Photo of the different sections of the epididymal duct, and the maturity of the sperm located in each section. Photos courtesy of Pathways to Pregnancy and Parturition

Spermatozoa that spend an unusually long time in the tail may be of poor quality when compared to sperm from animals ejaculated once to twice weekly.

The number of sperm removed from the tail reserve can be increased dramatically by subjecting the male to a series of sexual preparation maneuvers, such as false mounting or restraint from mounting.

When a male is exposed to several females in estrus at the same time there is a strong likelihood the male will select one of the females and inseminate her repeatedly. Such repeated insemination of a single female can deplete the reserves in the tail of the epididymis and thus compromise the chances of successful pregnancies in other females that are in estrus the same day

Spermatozoal removal from the epididymis is caused by periodic contractions of the epididymis and ductus deferens, resulting in a gradual trickle of spermatozoa out of the tail, through the ductus deferens, into the pelvic urethra where they are flushed out of the tract during urination.

Accessory sex glands are responsible for production of the liquid portion of the semen called seminal plasma. This fluid is not required for fertility but it is important for natural insemination.

Seminal Plasma is produced by:

- Epididymis
- Ampulla
- Vesicular glands
- Prostate gland
- Bulbourethral gland

The penis is the copulatory organ and consists of three parts:

1. Base: The attachment point
2. Shaft: The main portion
3. Glans: Specialized end

Stimulation of the glans penis is the primary factor initiating the mechanism of ejaculation.

The bull penis is a fibroelastic penis meaning there is limited erectile tissue and the thus stiffening occurs without significant change in diameter. Animals with a fibroelastic penis have a sigmoid flexure. The sigmoid flexure allows the penis to be retracted inside the body until erection occurs.

Factors Affecting Bull Fertility:

- Structural Soundness
- Capability of Reproductive Organs
- Semen Quality
- Level of Libido
- Plane of Nutrition

These factors should be assessed during a bull health exam

Structural Soundness:

The animal should be able to travel the breeding pasture. The bulls needs to have functional feet, legs, and associated joints. Bulls need a moderate angle to their rear legs in order to thrust.

Capability of Reproductive Organs:

Testicular movement is affected by the presence of fat pads, scar tissue and a small scrotum. Testicles that are soft indicate degeneration of tissue and poor semen quality. Small testicles indicate unsatisfactory development of the testis and limited sperm production.

Capability of Reproductive Organs (Common penile problems):

- Spiral deviation – Penis is twisted instead of straight. Bulls with this defect produce fewer pregnancies than normal bulls.
- Persistent Frenulum – This is a genetic disorder that can be corrected by surgery. The tip of the penis remains attached to the sheath and cannot be extended.
- Penile hair rings – This problem arises when a band of hair encircle the penis. If left untreated infection and scarring may result.

Semen Quality:

When evaluating quality you need to look at both sperm morphology (structure) and sperm motility (progressive forward travel). For semen to be considered good quality the spermatozoa need to have >40% progressive motility and <25% abnormal morphology.

Level of Libido:

Libido is the measure of a bulls sex drive. Libido can be estimated by measuring the animal's serving capacity, or the number of mounts and services he completes in a given time period. Social interactions affect an animal's libido. The most dominant bull tends to complete the highest number of services.

Cow to Bull Ratio	
Bull Age	Number of Cows
Yearling	15-20
2 Year Old	20-30
3+ Years	30-40

Plane of Nutrition:

During the breeding season bulls tend to eat less and use stored body fat. Therefore, pre-breeding nutrition is essential. A bull can lose up to 150lbs during one breeding season.

Bull Health Exam should be conducted:

- Yearly
- With a new purchase
- On all new bulls
- Prior to semen collection for artificial insemination use
- Prior to sale
- If infertility or pathogen is suspected

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