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BREEDING SOUNDNESS EVALUATIONS AND BEYOND

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Reproductive success is generally considered the most important factor in beef herd profitability and the bull is the one individual most responsible for success or failure. The vast majority of beef herds in the Southeast are still bred using bulls in a natural mating situation and the bull's ability to impregnate females as soon as possible is the key to a successful breeding season. It has been estimated that about 20% of bulls have some problem that can affect their reproductive success and identifying these bulls before the breeding season has long been the goal of those testing bulls for potential fertility.

Most bulls are fertile. The term fertile, as applied to bulls, implies the ability to impregnate cows at a high enough rate that herd pregnancy rate is not limited by the bull. However, what it takes to be a fertile bull will vary quite a lot with the number of cows the bull is exposed to, the length of the breeding season and other factors. Infertility in the bull would be present when the bull is incapable in impregnating cows but he could improve with time or treatment. For example, before reaching puberty all bulls are infertile. Sterile bulls cannot impregnate cows at all and cannot conceivably regain their fertility. A bull with a birth defect where both epididymi are missing would be sterile. The majority of problem bulls are subfertile. These bulls can impregnate cows but do so at a less than desirable rate. A perfect system of bull evaluation would not only be able to accurately rate bulls based their fertility, but also determine relative fertility among bulls and establish the proper bull to female ratio for that particular bull. Unfortunately, no such system exists at present.

To begin, it is appropriate to write a job description for the bull and mine follows. **A good bull should spend most of his time looking for cows in heat and mate often with those cows. He should produce pregnancies early in the breeding season resulting in the unassisted birth of calves that grow rapidly up to sale time. The bull should be able to perform well for a number of years and be safe to be around.** Tennessee data from our Master Beef Producer program participants in 2004 gives some insight into the world of bulls. Most of these participants were commercial beef producers. Sources for the bulls included:

Raised on the farm-8.6%
Purchased at a purebred sale-22.3%
Private treaty sale-46.1%

Production tested bull sale-7.2%
Sale barn-3.5%
Lease-6.7%

Listed below are the percentage of buyers that used a given criteria for selection of the bulls they buy:

Breed-63%
EPD's-14.7%
- BW EPD-8.3%
- WW EPD-1.47%
- YW EPD-0.97%
- MILK EPD-0.66%

Conformation 4.5%
Disposition-2.11%

Twenty eight % of the respondents had their cows pregnancy checked and 22% had Breeding Soundness Evaluations done on their bulls (Dr. Jim Neel, unpublished data). The take home message is that even the better end of Tennessee beef producers don't consider fertility when selecting bulls and a small proportion have their bulls evaluated for potential fertility.

In Tennessee and across the US, the majority of producers use yearling bulls for at least a part of their bull battery and this is the group where fertility problems are most likely to be encountered since bulls that don't do well as yearlings tend to be culled and bulls that do well their first breeding year tend to do well in later breeding seasons (Kasari, et. al., 1996). Yearling bulls are the kind most available and have been shown to be less expensive per cow bred over their lifetime when compared to bulls purchased at an older age. (Kasari, et. al., 1996)

A Breeding Soundness Evaluation (BSE) is intended to be a systematic and thorough examination of the bull that will lead to an estimation of the bull's fertility on the day examined (Hopkins, 2003). A poorly or incompletely done BSE is not very useful at predicting fertility in the bull and a well done BSE cannot find all bulls with fertility problems or determine relative fertility of bulls. Scrotal circumference measurement and semen morphology analysis relate best to bull fertility and special care should be given to these parts of the exam. The system most often used in the US is the Society of Theriogenology (1993) system (Hopkins et. al., 1997) and most bulls evaluated worldwide are evaluated with a similar system. Research has shown that the BSE is cost effective since bulls that pass the examination will sire about 10% more calves during the breeding season. In addition their calves will be born earlier in the calving season and be sold at a heavier weight. It has been estimated that the producer will realize a 20 to 25 dollar return for each dollar spend on BSE's.

In Tennessee, the most likely bull to have a BSE performed is a yearling bull. A yearling bull submitted for examination should be at least 1 year of age, weigh at least 1000 pounds and have a scrotal circumference of at least 30cm. Bulls not meeting these

criteria will often fail the exam because they are not yet sexually mature and have poor semen quality. Generally, bulls are best examined 1 to 2 months before the beginning of the breeding season so that bulls failing the examination can be replaced and have an opportunity to become familiar with their new surroundings.

A BSE consists of 4 parts, the physical exam, the reproductive exam, semen analysis and interpretation of the results (Spitzer, JC, Hopkins, FM, 2003).

The physical examination should include all those things that are important to mating success in the bull. Any physical problem that the bull has can have an effect of his willingness to mate and his semen quality. Body condition scoring is an important part of the examination. Bulls that are in poor body condition typically have less stamina in the breeding pasture and also often have poorer semen quality. Bulls that are too fat have lower sex drive and also may have poorer semen quality. Generally, bulls should have no ribs visible at the beginning of the breeding season and be fed to stay that way for the entire breeding season. Bulls having less than a BCS 4 are unlikely to be successful.

A bull must be able to move comfortably with the cowherd and bulls that have significant conformation problems or lameness are more likely to perform their job poorly. Finally, good eyesight is important to the bull's ability to identify females in heat and eye problems can quickly become fertility problems.

The bull's reproductive system should be examined completely. Abnormalities of the penis, testicles and internal sex glands are all encountered with some frequency. As mentioned earlier, the most important and useful measurement of the reproductive system is scrotal circumference (SC). This measurement is easily taken and relates well to the daily sperm output. The more sperm a bull makes and ejaculates, the more likely pregnancy is to occur. The minimum scrotal circumference for various ages of bulls is the same for all breeds. The minimum scrotal circumference for beef bulls is:

12 to 15 months - 30cm
15 to 18 months - 31cm
18 to 21 months - 32 cm
21 to 24 months - 33 cm
24 months and older - 34cm

Penile problems occur in a small percentage of bulls, but when these problems are present, fertility is likely to be affected, often permanently. Infections of the vesicular glands are seen most often in young bulls and bulls over 10 years of age. Bulls with this problem will sometimes ejaculate pus and this reduces (or eliminates) fertility.

Semen can be collected from most bulls most of the time. The most common method used for semen collection in the beef bull is electroejaculation. Low voltage, low amperage current is passed to nerve centers responsible for ejaculation by a rectal probe. This method requires no training for the bull and no other animals need be present. Semen collection is successful about 95% of the time. While some concern has been expressed about animal discomfort associated with electroejaculation, newer equipment and an

experienced operator make the process relatively stress free. Bulls can be collected very successfully using an artificial vagina but this method requires training for the bull plus collection animals, equipment and experience that most operators do not have. Rectal massage for semen collection is successful about 80% of the time and is more successful in the younger bull.

Semen motility is a measures the percentage of sperm that are alive. Under field conditions, low semen motility estimates are more often cause by the physical conditions under which the semen is evaluated rather than a bull problem. Generally, a drop of semen on a warmed slide is quickly evaluated under a light microscope at 400X. Semen motility measured in the field generally does not relate well to fertility in that bull. The SFT system requires a minimum of 30% motility, which recognizes that this exam often occurs under adverse conditions and the percentage of cells seen moving is often lower than the actual motility of the sample when ejaculated.

Semen morphology is generally done with a light microscope under oil immersion at 1000X. Slides are stained with one of several stains to kill the sperm cells and provide contrast so that the cells are easier to see. Several systems to evaluate the severity of abnormalities have been proposed. However, at present, total abnormalities seem to be the best method of measuring morphology as a method to predict fertility. Abaxial midpieces and looped tails, though listed as abnormal in the SFT (1992) system, do not appear to affect fertility. Semen morphology, when used in conjunction with other measures, does appear to be a good predictor of fertility in the bull. Under the SFT (1992) 70% of cells must be shaped and formed normally for the bull to be considered satisfactory. Phase contrast microscopy and other more advanced equipment generally allow the operator to find more and more types of abnormal cells but this sort of equipment is not available in most circumstances.

To be considered a satisfactory potential breeder, a bull must have no physical abnormalities that would affect his mating ability, no abnormality of the reproductive system that would decrease fertility, a scrotal circumference above the minimum for his age, at least 30% sperm motility and at least 70% normal sperm morphology. Bulls that have some problem that will likely improve with time or treatment are rated as classification deferred and another exam in 1 to 2 months is generally recommended. Bulls that have a problem that is not likely to improve as classified as unsatisfactory.

The BSE attempts to predict fertility on the day the exam is performed and fertility can change quickly during the breeding season. Substantial loss of body weight, lameness and reproductive injury are common reasons that bulls become less fertile during the breeding season (Ellis, 2004).

A number of scientific publications, including Kennedy et.al., 2002, have reported on the results of BSE's on large numbers of bulls. This study involved yearling bulls in TN and SC and reported that 76.2 % of the bulls passed the exam. Four percent of bulls failed to pass the exam due to inadequate sperm motility, 7% due to excess abnormal sperm morphology, 2.6 % due to both motility and morphology problems, 7.1% due to

inadequate scrotal circumference and 3.1 % due to physical abnormalities. The scrotal circumference of the bulls that passed the exam averaged 35.8 cm while those that failed averaged 33.0 cm.

The BSE, as is currently done, does not cover all the factors that can affect fertility in the bull and much research has been done to develop better testing methods or other tests, which could add to the value of the BSE. To date, none have been routinely adopted for field use in the US.

Libido is defined as willingness to mate and is generally considered to be an important part of bull fertility. Libido cannot be accurately measured by simple pasture observation and several testing methods have been devised (Chenowith, 1997). Libido testing is relatively commonly used in Australia, New Zealand and South Africa but is not often done in the US. Libido test are cumbersome, and controversial from an animal welfare perspective (Australia has a law governing their use). Also, libido tests done on yearling bulls tend not to be very repeatable the next year, as the bulls have learned to be more effective at mating. A simple Service Test has been proposed. To be satisfactory, a bull must complete one service of a female, be free of musculoskeletal and reproductive system problems and be free of other problems, which might reduce mating ability.

Fertility Associated Antigen (FAA) testing has been shown in various research trials to be positively related to bull fertility (Bellin, et.al., (1998), Sprott, et.al., (2000)). A 9 to 16 % fertility advantage for bulls having this protein on their sperm membranes was reported. These bulls had other fertility testing done prior to the FAA determination to eliminate bulls with certain other problems. However, at present it appears that a bull side test for FAA is not available and the cost of such a test is not known.

Automated semen quality analyzers are available which measure semen concentration, and motility are available (Hoflack, et.al., 2005, Farrell, et.al., 1998, Gravance, et.al. ,1996, Atkins, et.al., 2003). However, neither of these measures is highly related to bull fertility. Some of these units can also read sperm morphology but this function needs more work to be useful. Also, these units are very expensive ($30,000 to $50,000) and they are not very portable.

Infrared thermal imaging systems have been reported to be able to predict fertility based on the temperature patterns of the bulls scrotum (Lundstra and Coulter, 1997). These researchers were able to relate this thermal pattern to sperm morphology. Thermal imaging systems are easy to use and are quite portable. However, a computer must analyze the resulting thermal image and the unit is expensive ($20,000).

Measurement of various blood hormone levels have been tested as a way to predict fertility since hormones are a vital part of the reproductive success particularly in the area of libido and sperm output (Parkinson, 2004). Some researcher found that measurement of LH or Testosterone after administration of GNRH was a useful way to predict fertility (Post, 1987), while others have not (Byerly et.al., 1990, Murase et.al., 1990). Hormone measurement generally cannot be done bull side but rather requires laboratory facilities.

Various physical characteristics of the bull have been measured and an attempt made to relate the measurement to fertility in the bull. None have proven very useful. Recently, the shape of the whorl pattern on the bull's forehead (round or long) was recorded and compared to semen morphology results with favorable results (Meola, et.al., 2004). However, we were unable to repeat these results in bulls at the UT Bull Test Station (Gill, et.al, unpublished data).

The search continues for a perfect system to predict bull fertility, but the system does not yet exist. It appears that, for now, the Breeding Soundness Evaluation is the most practical and useful system available.

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