BULL BREEDING SOUNDNESS EXAMINATIONS AND BULL: COW RATIOS: RECOMMENDATIONS-OLD AND NEW

Auburn University College of Veterinary Medicine
Jim Wenzel

The evaluation of bulls for breeding soundness has changed over the many years since its advent, and continues to evolve as additional insights come to the fore. These proceedings are an overview of the history of these systems, with some suggested inclinations toward changes which may occur, in future.

The Very Old System

The breeding soundness examination of bulls (BSE) developed by the Society for Theriogenology (SfT) stemmed from the need to establish standards for evaluation of breeding bulls. In the late 1960's and early 1970's, bulls were evaluated for physical soundness, and semen was examined for vigor by observing gross motility, concentration by visual appraisal, and live/dead ratio using eosin/nigrosin as a vital stain.

The Old System

Beginning in the mid-1970's, other parameters were considered: examination of bulls consisted of physical examination, and measurements of scrotal circumference, gross and progressive spermatozoal motility, and the evaluation of spermatozoal morphology for primary and secondary abnormalities. Standardized forms were copyrighted by the SfT in 1985. At that time, point scores (with a potential total score of 100) were assigned to the measurable parameters. Dispositions were assigned according to point totals of >60 ("satisfactory potential breeder"), 30-59 ("questionable potential breeder"), and <30 ("unsatisfactory breeder"). It was possible, and not uncommon, for bulls to be classified as “satisfactory” with a low score in one of the three measures, or moderately low scores in two of the three.

The Current System

The current SfT BSE form is a revision copyrighted in 1992. Standards of the form are not used to assign scores. Rather, a minimum acceptable measure in each of three parameters (scrotal circumference, motility, and morphology) is required to classify a bull as a "satisfactory potential breeder." The minimum acceptable scrotal circumference is adjusted according to age between 15 and 24 months, and currently requires a minimum of 34 centimeters for bulls older than 24 months. The minimum acceptable percentage of individual, progressive, spermatozoal motility is 30%. The minimum acceptable percentage of morphologically normal spermatozoa is 70%. A bull with physical shortcomings, and/or which does not meet one or more of the minimum measures, is classified as an "unsatisfactory potential breeder," or the disposition may be "classification deferred" pending subsequent examination for improvement of parameters which have potential to do so.

The expectation of bulls which are classified as satisfactory potential breeders is that they will settle (produce pregnancies in) 90-95% of *their fair allotment* of regularly cycling females (cows and heifers) in a restricted breeding season of 60-90 days. The *fair allotment* clause was (and, to some degree, still is) subject to opinion, but through the years, our group has standardized these recommendations in the "Auburn Formulae" (Wenzel *et al*, 2012):

"The size of a single-sire breeding group is N (1:N bull:cow ratio), meaning that the bull may be exposed to *up to, approximately,* N females:

using a bull < 36 months of age, N = (is approximated by) the bull's age in months;

using a bull $\geq$ 36 months of age, N = the bull's scrotal circumference in centimeters."

And, "When it is not possible or reasonable to divide larger groups of females into single-sire breeding groups, some accommodation must be made for the inefficiency of multi-sire systems. Our mentor, Robert S. ("Bob") Hudson, proffered this advice: each bull added to the first in a multiple sire breeding group may be expected to dependably serve only one-half of his compliment of cows or heifers (N, as calculated, above). Thus, for example, a breeding group of 100 females would require four adult bulls, if each had a scrotal circumference of approximately 40 centimeters: 40 females for the first bull and 20 for each of the additional three bulls, or:

$B = 1 + [(T\text{-}N) \,/\, \tfrac{1}{2}N]$

where B = number of bulls required, T= total female cattle in the breeding group, and N is the fair compliment of females calculated for single-sire groups, based on the characteristics of the bulls. This calculation depends on reasonable uniformity in size, age and scrotal circumference amongst the candidate bulls."

Changes in the Population under the Current System

As one might expect, since the current system has been in use for 25 years, there have been some changes in the parameters measured during BSEs, and in the breeds of bulls subjected to BSEs. In particular, Carson *et al* (2014) observed that, in bulls examined by Auburn clinicians, fewer bulls failed to meet minimum scrotal circumference standards in the 2000's than in the 1990's, presumably due to selection pressure by breeders and their buyers. This trend, however, was reversed to a degree from the 2000's to the 2010's with the increasing popularity, in Auburn subjects, of the Brangus breed. It behooves us, therefore, to note that the population may change in BSE parameter measures and/or breed composition.

It was precisely this observation that gave us pause to reconsider the standards, especially the minimum scrotal circumference, and recommend the increased use of bulls which exceed the minimum, by exposing those with larger scrotal circumference to more females. Hence, an increase in the minimum scrotal circumference for adult bulls to 36 centimeters bears discussion with producers who might otherwise be taken aback by such a new standard, should it come to pass.

Points of Consideration and Potential Changes

Some discussion occurs rather regularly among theriogenologists regarding the classification of certain morphologic defects. Auburn theriogenologists have long held that abaxial (or “acentric”) implantation (or “attachment”) of the midpiece is a primary defect in the bull, but the current form lists this abnormality as a secondary defect. The author continues to instruct in the Auburn tradition, but notes that when abaxial implantation is counted as deleterious, it is acentric in the extreme. Hence, an element of judgement based on experience enters the process, as is apparent in the current form’s guidelines for the distinction of “strongly folded or coiled tail” (a primary defect) versus “terminally coiled tail” (a secondary defect).

There exists general agreement that proximal cytoplasmic (or “protoplasmic”) droplets negatively affect fertility and, thus, are appropriately classified as primary defects. However, they are commonly found in a larger proportion of spermatozoa from young bulls, which typically decreases with maturity, so a preponderance of this defect in immature bulls carries with it a less damning prognosis. This is widely known but, as of yet, unaccommodated in the guidelines. There is less evidence and less agreement that distal cytoplasmic droplets negatively affect fertility, possibly because they may be shed in the female tract (Thundathil *et al*, 2014), so there may come a time when they are no longer considered a defect at all; for the time being, they remain a secondary defect.

Reversals (“reflex,” hairpin bends) of the distal midpiece are a common defect, which allegedly occurs in the epididymis (Thundathil *et al*, 2014), and so might be considered a secondary defect. However, this defect is most often accompanied by entrapment of a cytoplasmic droplet in the reversal, severely affecting the function of the sperm, so one may be correctly inclined to consider it a primary defect. When distal midpiece reversals are unaccompanied by entrapped cytoplasmic droplets, an alternative explanation may exist.

Reversals of the midpiece and principle piece occur in a large proportion of intact, healthy sperm when they are exposed to a hypo-osmotic (or hypo-osmolar) environment. This might be mistakenly considered a defect of the sperm, but it is an induced, tertiary (handling) change, and it is the basis of the hyposmotic swelling test (HOST), indicative of sperm with intact membranes. Our lab has long suspected that this is a quality control issue in the production or storage of the eosin-nigrosin stain which we use for semen evaluation. In fact, seven vials of recently purchased stain had a mean osmolarity of 151 mOsm/L, with a range of 135 to 169; normal osmolarity is in the vicinity of 309 mOsm/L. Therefore, when an excess of reversals of the midpiece and/or priniciple piece are observed, the osmolarity of the stain should be investigated. It is a simple, inexpensive measure that a clinical pathology lab can perform on a small amount of stain.

Alterations in our recommendations regarding bull:cow ratios may be justified, in future, given some research findings, old and new. "Serving capacity" trials used in other parts of the world, especially Australia, have shown that bulls can be reliably and repeatably selected for libido and aggressive breeding behavior. Not surprisingly, then, it was found some time ago and more than once, through paternity testing of calves, that certain individual bulls sired most of the calves in multi-sire breeding groups (Lehrer *et al*, 1977; Holroyd *et al*, 2002). Our lab is currently investigating, via pedometry, how much physical effort is expended by bulls in the breeding season, with potential to demonstrate a difference, between bulls, suggestive of greater breeding activity. A combination of these research modalities with genomic analyses may eventually allow the *a priori* identification of bulls with superior breeding capability, which could allow reduction of the recommended bull:cow ratios.

References

Carson,R., Koziol,J., Wenzel,J., *et al* (2014) Twenty year trends of bull breeding soundness examinations at a teaching hospital. <u>Clinical Theriogenology</u> 6(4):495-501.

Holroyd,R.G., Doogan,V.J., DeFaveri,J., *et al* (2002) Bull selection and use in northern Australia 4. Calf output and predictors of fertility of bulls in multiple-sire herds. <u>Animal Reproduction Science</u> 71:67-79.

Lehrer,A.R., Brown,M.B., Schindler,H., *et al* (1977) Paternity tests in multisired beef herds by blood grouping. <u>Acta Veterinaria Scandinavica</u> 18:433-441.

Thundathil,J.C., Dance,A.L., and Kastelic,J.P. (2014) Bovine sperm abnormalities: prevalence, etiology and mechanisms leading to infertility. <u>Clinical Theriogenology</u> 6(4):525-532.

Wenzel,J.G.W., Carson,R.L., and Wolfe,D.F. (2012) Bull-to-cow ratios: practical formulae for estimating the number of bulls suggested for successful pasture breeding of cattle. <u>Clinical Theriogenology</u> 4(4):477-479.