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BULL BREEDING SOUNDNESS EXAMS AND BEYOND

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History

The development of routine on-ranch bull testing coincided with technical advances in bull electro-ejaculation (EE) which permitted safe, relatively effective, semen collection of un-handled bulls. Approximately 50 years ago, the Rocky Mountain Society for the Study of Fertility in Bulls (RMSSFB) was formed "to share and disseminate the essentials for evaluation of beef bulls for fertility and to standardize procedures". A landmark report (Carroll et al 1963) on 10,940 bulls examined showed that on-ranch bull "fertility" testing was feasible. The RMSSFB subsequently became the Society for Theriogenology (SFT), which developed a revised breeding soundness evaluation (BSE) system in 1992, as described below.

Bull Breeding Soundness

The Breeding Soundness Evaluation (BSE) is a relatively quick and economic procedure for screening bulls prior to sale or use. Its objective is to establish a baseline, above which bulls could be regarded as satisfactory potential breeders. As it is intended for wide application with a variety of breeds in different environments, it needs to be simple, repeatable and unambiguous. However, the BSE should not substitute for professional judgment or common sense. In the BSE, bulls are placed into the categories of satisfactory, unsatisfactory and classification deferred. The process is most effective in identifying bulls at the lower end of the potential fertility spectrum. It is relatively less effective in predicting individual bull performance at the upper end of the fertility spectrum. Reasons for this include:

1. Fertility is a complex trait which is influenced by both male and female traits as well as by extraneous factors(e.g. nutrition, environment, disease etc).
2. The BSE aims to identify bulls which are satisfactory (not necessarily those which are superior).
3. The BSE is a relatively quick and simple screening procedure which does not comprehensively assess all aspects of male fertility.
4. Knowledge and understanding of male fertility keep increasing and changing.

BSE Procedures

A routine BSE generally includes the following:

1. Physical examination.
2. Reproductive examination (including measurement of scrotal circumference).
3. Collection and examination of semen.

In addition, a libido/serving capacity test may be included, as may special tests for diseases (e.g. vibriosis or trichomonosis). These procedures will add predictive value to the assessment process and may be specifically indicated in some situations, but they are not part of the routine BSE.

Limitations of the BSE include:
1. Results are most valid at the time of examination only.
2. The system works best to identify infertile bulls
3. It is not designed to predict the precise fertility of individual bulls
4. It does not routinely include assessment of bull libido and mating ability
5. It does not routinely include testing for infertility diseases.

Current SFT Thresholds

Revision of the American Society for Theriogenology 1975 bull BSE procedures resulted in the system (Chenoweth et al., 1992) described below.

For bulls to be classified as Satisfactory Potential Breeders, they must pass the physical examination and equal or exceed the minimal thresholds in each of the following categories:

Category	Threshold
- *Scrotal Circumference*	30 cm at # 15 mo
	31 cm at >15 # 18 mo
	32 cm at >18 # 21 mo
	33 cm at >21 # 24 mo
	34 cm at > 24 mo
- *Sperm Morphology*	$70% normal sperm
- *Sperm Motitlity*	$30% individual motility &/or "fair" gross motility

Bulls which do not equal or exceed these thresholds will either be classified as Unsatisfactory Potential Breeders or as Classification Deferred (as below).

Satisfactory

Bulls which equal or surpass minimum thresholds for scrotal circumference, sperm motility and sperm morphology, and which do not show genetic, infectious or other problems or faults which could compromise breeding or fertility.

Unsatisfactory

Bulls which are below one or more thresholds and which are highly unlikely to ever improve their status. Also, bulls which show genetic faults or irrevocable physical problems (including infectious disease) which would compromise breeding or fertility are included.

Classification Deferred

Any bull which does not fit into the above categories and which could benefit from a retest. Provision is provided for the scheduling of a retest. This category includes young bulls with an "immature" semen profile as well as any bulls whose semen is substandard but considered to be capable of improvement. Also bulls from which a representative ejaculate

was not obtained, as well as bulls with treatable problems. In general, if doubt exists concerning a bull's status, he should be considered as a candidate for a retest and placed into the "classification deferred" category.

Rationale for Current Thresholds

1. Minimum acceptable standards for scrotal circumference, sperm motility and sperm morphology.

Previous SFT BSE systems placed over-reliance on numerical scores. A bull could pass the BSE even if he was very poor in one particular category as long as other scores were high enough to give an overall passing grade. Also, scores could be used to "rank" bulls in terms of potential reproductive performance. Both approaches could lead to error and/or misrepresentation, especially as the original intention of numerical scores was to help place bulls in categories or groups. In general, the threshold standards selected are not overly rigorous. The case has been made to establish more rigorous thresholds to encourage genetic progress in reproductive traits. However, this approach was not adopted for several reasons. Firstly, it was considered necessary to have bull BSEs more generally accepted by industry before higher standards might be imposed. Secondly, producers need to have flexibility to select for other traits. Thirdly, it was acknowledged that current skills and knowledge were better able to detect animals which would perform at the low end of the fertility spectrum than at the top end. However, although the present system describes **minimum** acceptable standards only, higher thresholds may be implemented by veterinarians in consultation with their clients. In other words, the SFT BSE standards represent the backstop for reproductive adequacy. The use of higher standards wherever possible should be encouraged particularly with seedstock breeders and their associations.

2. Lowest scrotal circumference threshold of 30 cm.

Relatively low thresholds for scrotal circumference were selected for the reasons given above. **These are minimal acceptable measures for ALL bulls raised on a good plane of nutrition**. Most emphasis is placed on standards for pubertal bulls up to 2 years of age (i.e. the most common and most important test population). Even though variations occur with age, nutrition level and genotype, the use of low thresholds provides considerable latitude. However, use of a minimal threshold lower than 30 cm. will depend upon individual professional judgement and it will have to be justified accordingly. Again, these thresholds are based upon considerations of reproductive adequacy and not necessarily upon those of optimal genetic merit.

3. 70% threshold for normal sperm morphology.

The practice of separately classifying different sperm abnormalities based upon underlying assumptions concerning their etiology and their significance has been severely challenged. The arguments for using a single threshold for "normal" sperm in the light of present knowledge receives support from a number of sources (e.g. Barth and Oko (1989). It is reinforced by knowledge that many sperm abnormalities previously considered as discrete entities, may in fact reflect stages within a spectrum of standardized responses to stress by the spermatogenic epithelium (Larsen and Chenoweth, 1990; Vogler, 1990). This approach is not inconsistent with the pioneering conclusions of Lagerlof (1934) who argued that damage to spermatogenesis might well influence many more sperm than those with easily

discernable faults, and that a threshold level for satisfactory fertility appeared to exist. The threshold of 70% normal sperm is consistent ith the observations of Lagerlof (1934) and, more recently, work by Wiltbank and Parrish (1986). The threshold of 70% normal sperm does not make any distinction between types of abnormalities involved. However, the categories of "primary" and "secondary" sperm abnormalities were retained as they are often still used to assist in the mechanics of collating totals, prognosticating and monitoring progress, despite reservations concerning their underlying assumptions. A case was made to use the categories to "major" and "minor" (Blom 1972). However, it became apparent in discussion that the lists of sperm abnormalities in both systems were identical, at least in terms of practical application. It was considered that the "compensable/non-compensable" sperm anomaly classification system, as described by Saacke *et al* (1991), requires further refinement and testing before widespread use is recommended. It is quite possible that progress will mandate a further change to our sperm morphology assessment procedures before too long. In the interim, employment of an overall threshold for sperm abnormalities, as recommended herein, should lessen the emphasis and debate on the significance of particular categories of sperm abnormality.

4. 30% threshold for progressive (individual, %) sperm motility.

The use of a relatively low threshold for sperm motility is challengeable. Some consider that this should be higher while others question the inclusion of any estimate of sperm motility at all. Taking into account the varied and often trying environmental conditions encountered in the field, a higher threshold might well be an obstacle to general acceptance of this scheme, or at least to its proper observance. Similar sentiments were expressed in 1975 when the motility component of the BSE was reduced. It should be realized that this relatively low threshold in no way diminishes the potential importance of motility assessment when performed under optimal conditions.

5. Use of "Classification Deferred".

Some unease occurred with the term “questionable”, despite its widespread use for many years. The difficulty arose from the realization that being placed in this category almost invariably meant that a bull was destined for a retest; certainly it was intended as a temporary or "holding" category. Bulls might be placed in this category for many reasons, both trivial and serious. Whatever the reason for its application, the term "questionable potential breeder" could be misinterpreted and it could disadvantage the subsequent sale of such animals, even if they subsequently proved to be “satisfactory”. The substitution of a "classification deferred" category, a description which has neutral connotations, does not have such disadvantages. However, its does imply that a retest will be scheduled and a slot is provided for this purpose.

Thus, the B.S.E is.....

1. A Screening Test

The bull BSE represents a rapid, economic screening test which screens bulls for detectable problems and puts them into groups which generally behave as classified.

2. A Veterinary Procedure

In many parts of the world, the BSE is regarded as a veterinary procedure. As such, it represents a privilege, responsibility and accountability. The responsibility includes the assumption that the procedure will be done competently and professionally, without short-cuts or compromises. As a veterinary procedure, it is also assumed that the findings and recommendations will reflect sound professional judgment.

3. A Management Tool

The BSE should be part of management scheme to improve herd fertility, genetics and profitability. As such it can help implement decisions on bull numbers, ratios, rotation and group composition. It should also play a role in genetic selection and planning. Lastly, the BSE is an important tool in infertility investigation.

4. A Sound Investment

A conservative estimate may be made of a 6% or greater fertility advantage for bulls passing a BSE and/or semen quality thresholds over unevaluated bulls (with larger differences possible when satisfactory bulls are compared with those which fail the BSE). In addition to increased calf crop, benefits accrue through increased weaning weights of older calves at weaning because females become pregnant earlier in the breeding season. Based upon current U.S. prices, a 6% increase in calf crop at weaning would represent an approximate return of $20-$25 for each $1 invested in the BSE. Additional benefits accrue via increased weaning weights (more females pregnant earlier) and subsequent improvements to herd fertility via male-female genetic links.

5. A Welfare Issue?

Welfare concerns with bull BSE are mainly with the use of electro-ejaculation (EE) to obtain semen. The introduction of effective EE allowed routine testing procedures with unhandled range beef bulls. Such bulls cannot be safely collected with an artificial vagina (AV), while collection via per-rectal massage can be inconsistent. Semen collected via proper use of EE is comparable to that obtained with an AV. In addition to its advantages with range-type bulls, EE also allows semen to be collected from bulls in which physical problems rule out AV collection. However, EE does cause some discomfort to bulls, although improvement in probe design and machine circuitry have led to a marked reduction of such signs. One study ascertained that bull heart rates were less when an epidural was given prior to EE, although no comparison was made with other activities, either painful or pleasurable. Other work showed that, whereas blood cortisol levels were elevated with bull EE, these were not as high as those due to restraint alone, or per-rectal palpation. With rams, EE did not result in higher cortisol levels than either shearing or restraint. A relevant question is whether or not EE is a routine, useful managerial procedure. If so, does it cause more distress than other such procedures? Does it cause unnecessary pain or harm? This debate may differ between regions with predominantly natural breeding systems (e.g. the

Americas and Australasia) and those in which A.I. predominates (e.g. Europe). Although male fertility is important for both, it is usually assessed with unhandled bulls in the former case, compared with bulls which are used to handling and A.V. collection in the latter. For unhandled bulls, the choice is either to employ a method of semen collection which poses minimal danger to both man and animal (e.g. EE), or to avoid semen assessment altogether; an option that would lead to decreased fertility in breeding herds, add to the economic burdens of producers and increase strains on natural resources. If EE is a useful, routine managerial tool, then it is still valid to ask whether or not the pain outweighs the gain. Although objective studies are lacking, observations indicate that this procedure is no more distressful than other accepted procedures such as vaccination or lateral restraint. Thus bull EE may be considered as a valid and useful veterinary procedure which should be performed as humanely as possible.

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