Physiology Symposium: The role of the AI sire in maintaining reproductive rates of Holstein cows

260 Relationship between conception rate and in vitro sperm viability. J. J. Parrish*, *University of Wisconsin, Madison, WI.*

It has been the goal of many scientists to develop in vitro methods of predicting a bull's fertility. One approach has been to evaluate the viability of sperm. While it is obvious that a sperm must be viable to fertilize an oocyte, it is not clear what are the criteria that define a viable sperm. For example, viability stains that use histological stains such as eosin or fluorescent DNA binding molecules such as propidium iodide rely on a permeable plasma membrane to define a non-viable sperm. Evaluation of the percentage of non-viable sperm might be done using microscopy or flow cytometry for better accuracy but in either case only a single aspect of viability is addressed. Only modest correlations have been reported between this type of a viability measurement and bull fertility. Additional aspects of sperm viability or functionality need to be measured in order to improve the correlations. In the development of computer-aided methodology that evaluates sperm morphology and its relationship to bull fertility we found that only viable sperm morphology was related to bull fertility. The method used to assess the relationship of bull fertility to measures of semen quality is important as well. It is likely that identifying bulls with fertility below a desired threshold, diagnostic test approach, will be more productive than evaluating the relationship of a semen quality traits to fertility of all bulls. Approaches using multiple comparisons on viable sperm and diagnostic statistics need to be developed if bull fertility is to be predicted better. Supported by the College of Agriculture and Life Sciences and USDA-NRI.

Key Words: Sperm viability, Flow cytometry, Bull fertility

261 Accessory sperm and embryo quality: insights to male fertility. R. G. Saacke*, *Department of Dairy Science, Virginia Tech.*

Six-day-old non-surgically recovered bovine ova/embryos from single ovulating cows have been used as biomonitors to evaluate seminal deficiencies that are compensable (where fertility responds positively to elevated sperm dosage) and uncompensable (where fertility is depressed and does not respond to elevated sperm dosage). They have also been used to evaluate reproductive strategies and in some cases, the interaction of individual males with different strategies. The fertilization status and embryo quality of the six-day-old presumptive morula permits the independent evaluation of two major components contributing to pregnancy or its failure, i.e., fertilization status and embryonic development. In addition, quantitative and qualitative evaluation of accessory sperm provides some insight to the sperm available for fertilization either as a function of the male/inseminate or a specific reproductive strategy. Factors influencing sperm access to the ovum in vivo (based upon accessory sperm number per ovum/embryo) were differences due to: the male, the female, time of insemination relative to ovulation, the interaction of males with time of insemination, site of insemination, dosage of sperm per inseminate, interaction of male and dosage and superovulation. Major identifiable male factors depressing quality of embryos were associated with perturbations in spermatogenesis as reflected by altered sperm head morphology and/or incidence of sperm nuclear vacuoles in semen. Impacts of these factors on fertility appear to be exacerbated by superovulation. In agreement with field data, male/seminal factors influencing sperm access to the ovum (compensable) appear to be quite independent from those influencing embryo quality (uncompensable). Futuristically, meaningful laboratory testing of semen for fertility should ultimately consider compensable and uncompensable seminal deficiencies, sperm dosage, and the reproductive strategy to which the semen will be applied.

Key Words: Bull, Semen quality, AI fertility

262 Genetic selection for improved reproduction. K. Weigel*, *University of Wisconsin.*

Achieving pregnancy in high-producing dairy cows in a timely and cost-effective manner may be today's greatest management challenge. Fertility is highly influenced by management and environmental factors, but significant genetic differences exist in both male (service sire) and female (daughter) fertility. The first challenge in improving fertility through genetic selection is data collection, because an inverse relationship exists between quantity and quality. Rough measures, such as calving interval, are available for all multiparous milk-recorded cows. Insemination data (and non-return rates) are available for about half of the cows, while pregnancy exam outcomes are available for perhaps a quarter of the animals. Detailed data, such as technician ID and type of estrus (standing or synchronized) are available in selected herds, and milk progesterone data are typically limited to experimental herds. The second challenge is statistical modeling. Linear models are inappropriate for binary conception rates, and data of continuous traits, such as days open, are badly skewed. Threshold models are technically appealing, but extreme category problems can occur when contemporary groups are small (especially in animal models). Survival analysis can be used to evaluate days open or time from first insemination until pregnancy, and this allows inclusion of censored data (e.g., cows with no pregnancy exam). Models for longitudinal binary analysis may have the greatest potential, because direct genetic evaluation of 21-day pregnancy rate for individual animals is possible (e.g., did pregnancy occur in each successive 21-day interval after the voluntary waiting period). The third challenge is education of users. Results can be published in various ways, but each has limitations. The concept of a trailing 21-day pregnancy rate is understood by many producers, but some confuse it with non-return rate or conception rate. Differentiation between male and female fertility is an ongoing problem, so published information must be labeled concisely. Lastly, the negative relationship between milk production and female fertility creates challenges, because many sires with high genetic merit for production will have undesirable daughter fertility values.

Key Words: Fertility, Dairy cattle, Genetic selection

263 Sustaining the fertility of artificially inseminated dairy cattle: The role of the artificial insemination industry. J. M. DeJarnette, C. E. Marshall, R. W. Lenz, D. R. Monke, W. H. Ayars, and C. G. Sattler, *Select Sires, Inc., Plain City, OH, USA.*

As the dairy industry strives to thwart an apparent decline in reproductive efficiency, the fertility of the male must not be overlooked. The fertility potential of an artificial insemination (AI) dose is a function of the quantity, quality and health status of the semen contained therein. Management of sire health and associated disease testing protocols are paramount. Post-thaw semen quality evaluations combined with adjustments to cell numbers per dose and culling of ejaculates and (or) bulls, minimizes the variation in fertility potential of individual samples and (or) sires released for sale. Identification of additional semen quality attributes associated with fertility could provide more accurate methods to predict, manage and select for AI sire fertility. However, because the values of most "known" semen quality traits (motility, acrosome integrity, normal morphology) are highly correlated with each other, any "new" technology must not be evaluated in a vacuum but in light of existing methodology to consider the additive benefit in fertility prediction and (or) economic utility of implementation. Unfortunately, the association between semen quality and fertility is often limited by the accuracy of the fertility estimate. Cryopreservation techniques that extend post-thaw sperm survival and (or) reduce rates of capacitation may reduce sensitivity to insemination timing and are promising opportunities to improve fertility from the male perspective. The AI industry must increase research efforts to enhance, predict and measure fertility in both male and female bovine. The role of the AI industry representative has and will continue to evolve from that of salesperson and genetic advisor to that of reproductive and herd-management consultant. More emphasis must be placed on these characteristics in hiring practices and in advanced training in reproductive-management skills. The magnitude of the decline in reproductive efficiency that can be attributed to genetics is the subject of considerable debate. Through semen purchasing decisions, dairymen dictate the relative importance of various genetic selection criteria to the dairy industry and thereby the emphasis to be placed on these traits in AI sire-sampling programs.

Key Words: Artificial insemination, Fertility, Dairy cow