BEEF CATTLE REPRODUCTION SYMPOSIUM: **REBUILDING THE U.S. COW HERD: RETHINKING THE WAY INDUSTRY SELECTS AND DEVELOPS REPLACEMENTS**

0112 Rebuilding the U.S. cow herd: Rethinking the way industry selects and develops replacements. D. S. Brown* and D. J. Patterson, *University of Missouri, Columbia.*

The U.S. beef industry is confronted with a significant long-term decline in cattle numbers driven in part by record input costs and severe drought conditions in many major cattle-producing states. These recent challenges only add to the long-term issues the industry has faced, which include an aging producer population, increased global competition, increased competition from other meat proteins, weak domestic demand for beef, and a perceived lack of economic incentives to expand the cattle herd. The weakness in beef demand provided impetus for the industry to begin the Beef Quality Assurance program. Although the industry has experienced more consistency in beef products over the last 3 decades, there are major strides left when today < 5% of cattle grade Prime. In comparison with other domestic livestock sectors in the United States, tradition and segmentation within the U.S. cattle industry has hindered the adoption of newer production and marketing strategies. Coordinating the various industry segments (cow-calf, stocker, feedyard, processor) with allied industry (AI companies, seed stock suppliers, feed and pharmaceutical industries) offers the potential to enhance technology adoption and contribute to increases in production efficiency. As the U.S. cattle industry moves to rebuild its declining numbers, the focus of much of the industry will turn to heifer retention and appropriate practices related to beef heifer development. The industry has provided better beef quality signal transmission through available marketing grids in the industry today. Yet, these grids generally require cow-calf producers to maintain some ownership stake in the cattle through the feedyard. Producers who have invested in developing higher quality cattle and beef in the past often found genetic improvement to be slow and inconsistent, which oftentimes reduced economic incentives of quality focus. The technologies that have come online over the past few years and new genomic advances on the horizon appear poised to rapidly increase genetic improvement and consistency. The combination of better market incentives for higher quality beef coupled with technologies that allow producers to more easily invest in genetics focused on quality provide the industry a unique opportunity to increase the cow herd with a more refined focus on the genetic potential of the herd as it relates to efficiency and higher quality. It would appear these technologies have the added value of reducing producer risk by providing more consistency in the beef produced.

Key Words: economic, quality, technologies

0113 Physiology and endocrinology of puberty in heifers. J. Atkins*[1], K. G. Pohler[2], and M. F. Smith[2], [1]*American Simmental Association, Bozeman, MT,* [2]*University of Missouri, Columbia.*

Most beef producers expect their heifers to be able to calve for the first time at 2 yr of age. Frequently, the breeding season for heifers begins 2 to 3 wk before the beginning of the breeding season for cows. Furthermore, the fertility associated with the first pubertal cycle is reportedly lower than subsequent cycles. Therefore, having heifers that reach puberty 6 to 9 wk before the start of the breeding season can have a positive impact on conception rates and ultimately profit for producers. Additionally, heifers that conceive earlier in the breeding season, calve earlier in the calving season and have a better chance of conceiving the following breeding season. Early-calving heifers produce more calves in their lifetime and remain in production longer than later-calving heifers. Understanding the physiology and endocrine maturation leading to onset of puberty is critical to maximizing heifer development. Puberty, defined as the first ovulatory estrus, is preceded by progressive growth and development of the uterus, ovaries, and hypothalamic-pituitary-ovarian axis. Follicle waves endure longer, dominant follicles become larger, and oocyte competence improves as heifers approach puberty. The CL formed after the first ovulation and luteinization is short lived due to a premature release of $PGF2_{\alpha}$. This short exposure of progesterone followed by a rise in estradiol is important in establishing the appropriate timing of $PGF2_{\alpha}$ release and can be mimicked using a progestin in estrous synchronization protocols. Estradiol shifts from having a strong negative feedback on the hypothalamus and pituitary to a reduced negative feedback, and finally a positive feedback, causing the gonadotropin surge and ovulation (gonadostat hypothesis). The switch in the hypothalamic response to estradiol may be due to a drop in estradiol receptors, coupled with increased concentrations of kisspeptin and increased sensitivity to existing kisspeptin molecules by GnRH neurons. Producers can use reproductive tract scoring (RTS), a subjective measurement of the uterus and ovaries, to assess heifers' sexual maturity before the breeding season (4 to 6 wk, ideally). This gives producers enough time to make management decisions based on the RTS assessment. In summary, this paper/presentation provides a review of the research into the physiological and endocrine maturation leading up to puberty in beef heifers.

Key Words: beef, heifer, puberty

0114 Beef heifer replacement considerations related to breed and biological type. A. L. Van Eenennaam*, *University of California-Davis, Davis.*

The reproductive fitness of females is a major driver of profitability and fertility considerations should be given high priority when selecting the best replacement heifers. Selection for replacement heifers is based on their readiness and ability to conceive in the proposed breeding season, which places indirect selection on dam fertility, as fertile cows tend to conceive early and generate early-born heifers that are more likely to be selected as replacements. Age at puberty is variable among breeds and biological types (British < Continental < *Bos indicus* influenced), and is moderately heritable. The choice of breed(s) and breeding system play an important role in overall ranch profitability and before making a commitment to any breed or breeding system, the logistics, costs (including opportunity costs), benefits, and feasibility should be objectively evaluated for a given set of environmental, resource, management, and marketing constraints. Expected progeny difference (EPD) genetic merit estimates for heifer pregnancy (HP), stayability (STAY), and scrotal circumference (SC) are available for some breeds, and have all been positively associated with female fertility. Heterosis (also known as hybrid vigor) occurs when the performance of the crossbred progeny for a specific trait is greater than the average of their parents. Heterosis effects are significant and important for low heritability fitness and survival traits, such as longevity, lifetime production, and reproduction rate. Improvements in cow-calf production due to heterosis result from both the improved maternal performance of the crossbred cow and individual performance of the crossbred calf. Complementarity results from crossing breeds of different but complementary biological types. This occurs when specialized sire and dam breeds are used in terminal systems to optimize performance levels. Properly designed crossbreeding systems, based on heterosis and complementarity, will generally out produce those based on straight breeding in productivity, but the challenge is to manage the program to produce progeny that meet market specifications and acceptance. The combination of AI and gender-selected, or "sexed" semen, offers the opportunity to rethink the logistics and economics associated with different breeding systems. Gender-selected semen provides the opportunity to develop novel breeding scenarios and avoid some of the logistical problems associated with the various crossbreeding systems. Emerging reproductive and genomic technologies offer exciting possibilities for innovative approaches to heifer selection and breeding program design; but as with all new technologies, enthusiasm needs to be tempered with a realistic evaluation of the costs and expected benefits.

Key Words: breed, complementarity, heterosis

0115 Nutritional development and the target weight debate. J. B. Hall*, *University of Idaho, Carmen.*

Postnatal nutrition has a profound effect on reproductive efficiency and lifetime productivity of beef heifers. A nutritional management strategy that focuses on allowing a high percentage of heifers to achieve puberty before the breeding season while reducing feed costs is the goal of most operations. Both preweaning and postweaning nutrition affect age at puberty. Preweaning nutrition may have a greater effect than postweaning nutrition on the onset of puberty, but the impact of management is limited preweaning. Creep feeding or creep grazing may increase the incidence of precocious puberty in heifers. Similarly, exposure to high concentrate diets during early weaning may increase precocious puberty, but early weaning has variable effects on pregnancy rates in heifers. To some extent, postweaning gain can overcome preweaning nutrient deficiencies. However, it is currently unknown if postweaning nutrition can alleviate negative prenatal nutritional effects on reproduction. Energy is the primary limiting nutrient in beef heifer diets; however, protein must be adequate and may be the limiting nutrient in certain circumstances. A few studies indicate that heifers may benefit from supplementation with rumen undegradable protein. In general, the source of nutrients does not appear to be important as long as animal requirements are met. The nutritional requirements listed in the Beef NRC appear to be adequate for heifer development, but more studies validating the Beef NRC requirements for growing heifers are needed. Altering pattern of growth during the postweaning developmental period may offer opportunities for decreased development costs and perhaps enhanced cow longevity. The most practical benchmark for proper heifer development at the ranch level has been the target weight method. Recently, the traditional target weight of 65% of mature weight at breeding has been challenged. Achieving a target weight of 65% of mature weight by the beginning of the breeding season ensures nutrition does not limit reproductive success of heifers; however, it appears a target weight of 55% has application for some operations and may have positive effects on heifer longevity. At present, multiple nutritional tools are available to design systems or respond to environmental factors (i.e., drought) for developing replacement beef heifers. Proper analyses of the impact of these systems need to include long-term effects on cow reproduction and longevity.

Key Words: heifer, nutrition, reproduction

0116 Management strategies for adding value to replacement beef heifers: A working model—The Missouri Show-Me-Select Replacement Heifer Program. D. J. Patterson*[1], J. M. Thomas[1], D. S. Brown[1], J. E. Decker[1], W. J. Sexten[1], and S. E. Poock[2], [1]*University of Missouri, Columbia,* [2]*University of Missouri-College of Veterinary Medicine, Columbia.*

Utilization of existing and emerging management technologies enable beef producers to improve breeding performance of heifers during the first breeding season and during subsequent calving and rebreeding periods as 2-yr-olds. These practices ensure that heifers that enter herds as raised or purchased replacements contribute to the general performance and productivity of an entire cow herd immediately, and cumulatively long term. In 1996, extension specialists, veterinarians, beef producers, and allied industry in Missouri linked arms to develop and implement a plan that would impact long-term sustainability of beef herds across the state. This plan was focused on the cyclical reproductive process in beef cattle and involves 5 basic steps: 1) create an understanding of the importance of heifer development based on reproductive outcomes; 2) implement changes in heifer development that eventually spill over into the cow herd; 3) emphasize the importance of reproductive management, which becomes apparent as changes are implemented; 4) expand producer focus to genetic improvement; and 5) emphasize to participating herds that creation of a value-added product requires a re-evaluation of marketing strategies. These 5 steps have built equity in herds that embraced the plan; 17 yr later the Missouri Show-Me-Select Replacement Heifer Program has impacted the cattle industry statewide. The program objectives include: 1) a total quality management approach for health and management of heifers from weaning to late gestation; 2) increased marketing opportunities for and added value from Missouri-raised heifers; and 3) creation of reliable sources of quality commercial and purebred replacement heifers. The program incorporates all available tools to support long-term health, reproduction, and genetic improvement of replacement beef heifers and includes provisions for ownership, health and vaccination schedules, parasite control, implant use, weight, pelvic measurement, reproductive tract score, estrous synchronization, AI, service-sire requirements for BW- or CE-EPD, early pregnancy diagnosis, fetal aging, fetal sexing, and BCS. In a state that ranks second in total number of beef cows in production, the Missouri Show-Me-Select Replacement Heifer Program is a working model that integrates improvements in selection, management, health, and genetics into a total development, management, and marketing program through emphasis on reproductive outcomes. Impact in Missouri stemming from the Show-Me-Select program and the proof of concept it demonstrates raises the question as to whether it is time to standardize requirements used in the program to broaden its scope to other major beef cattle-producing states.

Key Words: Missouri, replacement beef heifer, Show-Me-Select