ADSA Production Division Symposium: Production efficiency of the dairy cow

349 Genetics of productive life. Chad Dechow*, *Penn State University, University Park, PA.*

Historic selection for yield has improved the efficiency of dairy production for individual cows and current interest in direct selection for feed utilization aims to further increase productive efficiencies. However, herd efficiency will improve only marginally if selection practices reduce cow fitness levels and increase herd replacement rates. US genetic evaluations for productive life were introduced in 1994 and remain a robust general indicator of cow fitness levels. Productive life credits are limited to a cow's lactation cycle with early lactation weighted more heavily than late lactation. There is considerable variation in herd-life with a genetic standard deviation of 5 mo despite a relatively low heritability (8%). Factors that influence herd life vary across herds and have shifted over time as herd management has evolved. The relationship of productive life with body size has become increasingly antagonistic over time, whereas the relationship with yield has gone from a moderately favorable to a low association. Given the current US Holstein population structure, productive life is strongly correlated with higher cow fertility and lower somatic cell score. Deriving the economic value of longer productive life is complicated by shifts in milk price, heifer rearing and replacement costs, and cull cow value. This has led to varying degrees of emphasis on productive life in different countries and across time. The evaluation of productive life is also complicated by the necessity of a cow's life-cycle to be completed before her true productive life is known. Despite such challenges, higher sire productive life has been demonstrated to be associated with lower rates of daughter mortality and early lactation culling across a range of management systems. As dairy cattle breeders continue to emphasize productive and economic efficiencies, the need to consider traits related to cow fitness levels are of increasing importance to ensure that selection for cow-level efficiencies do not diminish productive efficiency at the herd level.

Key Words: productive life, genetic, efficiency

350 Economics of production efficiency: Nutritional grouping. Victor E. Cabrera*, *University of Wisconsin-Madison, Madison, WI.*

Nutritional grouping of lactating cows under TMR feeding systems has been discussed in the literature since the 70s. Most of the studies have concluded that using multiple, more-homogeneous TMR feeding groups is economically beneficial because of either or both nutrient cost savings or improved productivity. Nonetheless, there is not yet an absolute consensus or wide adoption. Latest studies using optimal basis for grouping and optimal diet specifications are reporting consistently greater income over feed cost ($/cow per yr) with multiple TMR groups compared with 1 TMR (3 TMR = 46 to 77 and 2 TMR = 21 to 45). Critical factors that determine the economic value of nutritional grouping are (1) basis for grouping, (2) diets' specifications, (3) effects on milk production, and (4) additional costs. It has been strongly documented that grouping cows according to their simultaneous nutritional requirements (a.k.a., cluster grouping) is optimal. Cluster grouping is superior to other methods such as grouping by DIM, milk production, or production and BW combined. However, the dairy industry still uses less than optimal grouping bases. Using cluster grouping would enhance the positive economic impacts of multiple TMR. Next, groups diets' specifications seem not to be optimal either. The concept of lead factors, which are only based on group average milk production are heavily used. Nonetheless, diets should be more precise following overall group nutrient requirements. Providing more precise diets will also be in favor of grouping economics. Next, an area that requires further attention is the potential negative effects of grouping on milk production because of either or both social interactions or diet concentration changes. Although the literature is inconclusive on this, latest studies indicate that multiple TMR largely outperform economically 1 TMR even after considering plausible potential milk losses of grouping. Finally, additional costs of management, labor, facilities, and equipment required for grouping are farm specific. The few studies that integrated these factors in their analyses found that multiple TMR would still be economically superior to 1 TMR.

Key Words: nutritional feeding, feed efficiency, cluster

351 Potential benefits of nutrition on reproductive performance of high-efficiency dairy cows. Milo Wiltbank*[1], Paulo Carvalho[1], Alex Souza[1], Paul Fricke[1], Mateus Toledo[1], Roberto Sartori[2], Jose Santos[3], Guilherme Pontes[2], Daniel Luchini[4], Francisco Penagaricano[3], Hasan Khatib[1], Katherine Hackbart[1], and Randy Shaver[1], *[1]University of Wisconsin-Madison, Madison, WI, [2]University of Sao Paulo, Piracicaba, SP, Brazil, [3]University of Florida, Gainesville, FL, [4]Adisseo, Alpharetta, GA.*

During the last century, increasing milk production has been associated with decreasing reproductive performance. However during the last decade, there has been a dramatic improvement in reproduction even as milk production continues to increase. The reasons for improving reproduction are multifactorial with dramatic improvements in reproductive management programs, advances in cow comfort and health management programs, and a turn-around in the genetics of reproduction underlying some of these gains. In addition, older research and many recent studies indicate that gains in reproductive performance require optimized nutritional programs including 4 specific areas that will be emphasized in this presentation. First, nutritional deficiencies in the prepartum diet can affect reproduction. As an example, recent research indicates that supplementation during the last month before calving with vitamin E in marginally-vitamin E deficient dairy cattle decreased retained placenta and stillbirths and increased subsequent reproductive performance. Second, nutritional deficiencies near calving and during the first 21 d after calving can have substantial effect on subsequent reproduction. In a recent retrospective study and consistent with previous results, we observed changes in BCS during the first 21 d after calving were associated with dramatic differences in fertility in high-producing lactating dairy cows. Third, increased insulin during the week before AI, potentially due to diets with high non-fiber carbohydrates, can have negative effects on fertilization and reproductive performance of ruminants. Thus, reducing insulin by targeted but subtle changes in feed intake or energy composition of the diet could be used to improve reproduction. Fourth, optimization of amino acid composition of diets may improve reproductive efficiency. Our recent research demonstrates that supplementing rumen-protected methionine altered gene expression in early preimplantation embryos and reduced subsequent pregnancy loss in lactating dairy cows. Thus, inadequate nutritional programs can reduce reproductive performance and optimized nutrition may augment reproduction even in herds with enhanced genetics and reproductive management strategies.

Key Words: fertility, nutrition

352 Providing facilities to improve health, welfare, and productive life. Trevor J. DeVries*[1], Marina A. G. von Keyserlingk[2], and Daniel M. Weary[2], *[1]Department of Animal and Poultry Science, University of Guelph, Guelph, ON, Canada, [2]Animal Welfare Program, University of British Columbia, Vancouver, BC, Canada.*

Poorly designed and managed facilities cause injuries and increase the risk of health problems, including lameness and other infectious and metabolic diseases, whose high prevalence is a welfare challenge facing the dairy industry. Massive capital expenditures are made on housing systems for dairy cattle, with the aim of providing a comfortable environment for these animals–one that ensures adequate rest, protection from climatic extremes, and free access to an appropriate, well-balanced diet. Despite these laudable aims, housing systems do not always function well from the perspective of the cow—poorly designed and maintained facilities can reduce feeding and lying time, increase competitive interactions, cause injuries, and increase the risk of health disorders. This review will focus on examples from empirical work on the feeding, standing, and lying areas utilized by dairy cattle, and show how these can be better designed and managed to meet the behavioral needs of dairy cattle, and thus improve welfare, health, and in some cases, productivity. Much of the research reviewed has evaluated housing systems from the cow's perspective by asking how the housing affects cow health, what elements of the housing environment the cow prefers, and how the these elements affect behavior and welfare. This presentation will focus primarily on free-stall housing and will first, identify science-based solutions that result in improved health and welfare of dairy cows and, second, identify gaps where further research is needed.

Key Words: dairy cow, housing, welfare

353 Precision dairy monitoring technologies as tools to improve dairy production efficiency. J. M. Bewley*, R. A. Russell, A. E. Stone, B. A. Wadsworth, K. A. Dolecheck, M. R. Borchers, M. E. Weatherly, L. M. Mayo, I. C. Tsai, M. C. Hardy, and J. M. Klefot, *University of Kentucky, Lexington, KY.*

Technologies are changing the shape of the dairy industry across the globe. In fact, many of the technologies applied to the dairy industry are variations of base technologies used in larger industries such as the automobile or personal electronic industries. Undoubtedly, these technologies will continue to change the way that dairy animals are managed. This technological shift provides reasons for optimism for improvements in both cow and farmer well-being moving forward. Many industry changes are setting the stage for the rapid introduction of new technologies in the dairy industry. Dairy operations today are characterized by narrower profit margins than in the past, largely because of reduced governmental involvement in regulating agricultural commodity prices. The resulting competition growth has intensified the drive for efficiency resulting in increased emphasis on business and financial management. Furthermore, the decision making landscape for a dairy manager has changed dramatically with increased emphasis on consumer protection, continuous quality assurance, natural foods, pathogen-free food, zoonotic disease transmission, reduction of the use of medical treatments, and increased concern for the care of animals. Lastly, powers of human observation limit dairy producers' ability to identify sick or lame cows or cows in heat. Precision dairy management may help remedy some of these problems. Precision dairy management is the use of automated, mechanized technologies toward refinement of dairy management processes, procedures, or information collection. Precision dairy management technologies provide tremendous opportunities for improvements in individual animal management on dairy farms. Although the technological "gadgets" may drive innovation, social and economic factors dictate technology adoption success.

Key Words: precision dairy, monitoring, technology