787 Mortality rate of dairy calves in a calf rearing farm (CRF).
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Calf rearing farms (CRFs) in Argentina are properties where calves are custom raised until they are approximately 90–120 d old. Both heifers and male calves are reared on CRFs with the number of male calves increasing over the past few years due to the opportunity cost in meat price for heavier and leaner animals. Little information has been published about CRFs and the performance of calves reared on these farms is unknown. Therefore the aim of this study was to evaluate CRFs due to the opportunities they offer to overcome the limitations faced by the dairy industry, including lack of labor, land and increased costs of production. Data was collected from the CRF's database and included 39,340 calves (21,028 heifers and 18,312 bulls) from 26 farms reared between 1994 and 2012. From the day of their arrival on the CRF up to 90 d of age, calves were individually tied up to a stake which held a stand used to place the buckets for feeding milk (4 L/head/day) and concentrate (Calf Starter; 0.1–3 kg/head/day). From 90 to 120 d of age, calves were housed in-group pens (30 calves per pen) with shade, and shared feeding and watering facilities. Effects of farm of origin, sex, live weight (LW) at entry, condition of entry, distance traveled from farm to CRF, month and year of birth on mortality rate and survival time were analyzed by multiple logistic regression models using Genstat version 14. Farm of origin, sex, condition of entry, distance traveled from farm to CRF, month and year of birth had no significant effect on mortality rate and survival time. The overall mortality rate observed was 4.2% which is well below to that reported in private farms in Argentina (7.5–15.4%) and reflects the high standard of management offered in this CRF. It was observed that survival time was associated with LW at entry ($P < 0.001$), with calves surviving 0.83 d longer for each extra kg of LW at the time of entry. Simple interventions during the peripartum period (separation calf-dam and colostrum management) might have the potential to significantly reduce the effect of calf LW on calf mortality and survival on CRFs.

Key Words: dairy calf, calf rearing farm, mortality

788 A mechanistic model for estimating water excretion in dairy cows.
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Reliable estimates of fresh manure water contents would improve predictions of nutrient transformations during manure storage. The objective of present study was to propose a mechanistic mathematical model to determine water excretions in urine (WU) and feces (WF) of dairy cows. The model included 3 body water pools; rumen water (Q_R), post-rumen water (Q_{PR}), and absorbed-water (Q_{AB}). Inflows to Q_R pool were saliva, drinking water and water in feed, and outflows from the pool were absorbed water and water passing to the Q_{PR}. Water from Q_R and drinking water bypassing rumen were inputs to Q_{PR}, and absorbed water and water to feces were outflows. The Q_{AB} pool had inputs from absorbed water flows from Q_R and Q_{PR}, and outflows were water in urine, milk, saliva, water for growth and maintenance and evaporated water. Saliva flows were determined with a function of dry matter intake (DMI). Drinking water flows were estimated with a linear function of DMI, dry matter (DMP), organic matter (OMP) and crude protein (CP) contents of feed. Fractional rates of absorption flows from Q_R and Q_{PR} were respectively adjusted for DMI and dietary acid detergent fiber (ADF) contents. Water flow to urine was determined as a linear function of Q_{AB}, CP, and milk yield. Water flow to milk was calculated with milk yield and a coefficient of water content in milk. Model was internally evaluated using 600 observations of daily WF and WU from dairy cows with respect to DMI, DMP, OMP, CP, ADF, and milk yields. Mean square prediction error (MSPE) was calculated and decomposed to systematic (SB) and random (RB) bias. Root MSPE was expressed as a percentage of mean observed values (RMSPE). Predictions of WF and WU were associated with 19 and 28% RMSPE respectively and about 97% of the MSPE was due to RB. The model was externally evaluated with an independent data set of 594 observations. Predictions of WF and WU had 29 and 34% RMSPE respectively with10 to 25% coming from SB. The proposed model appeared to reasonably predict WF and WU of dairy cows. Model reparameterizations addressing the SB could further improve model prediction accuracies.

Key Words: dairy cow, mathematical model, water excretion

789 Predictors of the heat stress response in lactating Holstein cows.
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Heat stress (HS) threatens the economic stability of the dairy industry and global food security. Study objectives were to identify predictors of the HS response in lactating dairy cattle. Data from 6 studies (Rhoads et al., 2009, 2010; Shwartz et al., 2009; Skrzypek et al., 2010; Wheelock et al., 2010; Baumgard et al., 2011) were combined into one data set. All cows ($n = 123$) were in a thermoneutral period (TN; P1; 19 ± 1.1°C) followed by either a HS (cycling 30.0 to 38.7°C; $n = 82$) or a pair-fed thermoneutral (PFTN; $n = 41$) period (P2) for 7 d. Correlations between indices of rectal temperature (Tr), respiration rate (RR), milk yield (MY), and dry matter intake (DMI) during TN, HS and PFTN were examined using a Pearson correlation in SAS. During P1, only MY ($P < 0.01$, $r = -0.46$), Tr ($P < 0.04$, $r = -0.23$), and RR ($P = 0.03$, $r = 0.24$) were associated with MY decrease during HS, and only P1 MY ($P < 0.01$, $r = -0.43$) and DMI ($P = 0.03$, $r = -0.34$) were associated with the MY decrease during PFTN. P2 DMI was negatively associated ($P < 0.01$) with the percent MY decline for both HS ($r = -0.46$) and PFTN ($r = -0.56$). Tr response on d 1 of HS was associated with percent P2 MY decline ($r = 0.63$), total MY loss ($r = 0.56$), MY slope ($r = -0.49$), and average MY decline per d ($r = 0.56$). Average P2 daily RR was correlated with Tr ($P < 0.01$, $r = 0.31$); however, morning RR was a better indicator of average daily Tr during HS ($P < 0.01$, $r = 0.40$) compared with evening RR ($P = 0.03$, $r = 0.25$). In summary, only TN MY and Tr response slightly predicted MY decrease during HS and this supports the dogma that high-producing dairy cows are more susceptible to heat stress.

Key Words: heat stress, dairy cow, production parameters

790 Visualization of lifetime profitability curves in Quebec dairy cattle. H. Delgado*[1], R. Cue[1], A. Sewalem[4], R. Lacroix2,1, D. Lefevre[2], E. Bouchard[3], J. Dubuc[3], and K. Wade[1], *[1]Dairy Information Systems Group, McGill University, Montreal, QC, Canada, [2]Valacta, St. Anne de Bellevue, QC, Canada, [3]Université de Montreal, St. Hyacinthe, QC, Canada, [4]Agriculture and Agri-Food Canada, Guelph, ON, Canada.*

Data from veterinary-health and dairy-herd improvement (DHI) sources were combined (56,121 animals from 663 herds) to perform a diagnosis and analysis of the different factors affecting lifetime profitability in Québec dairy cattle. Lifetime profit was calculated by deducting costs for heifer rearing, feed, breeding and health from current milk prices. DHI-recorded events were used to calculate age at first calving and the cumulative lifetime events (health episodes and breeding services). Costs for these various events were estimated based on current Québec figures. Information was normalized and compiled, and lifetime records were created using SAS 9.2. Animals in the data set started their first lactation between 2000 and 2011. For the lifetime analysis, all animals were required to have a code for "left herd reason" and a corresponding date. Individual curves were developed for animals with reported health episodes, and compared to animals with no reported health problems. This visualization of the curves allowed for the monitoring of an individual animal's lifetime profit and especially demonstrated how it may be affected by age at first calving, extended calving intervals and health issues. To maximize the validity of the analysis, animals were selected from herds that routinely recorded health events. From this resulting subset of the data, first-lactation animals with mastitis, displaced abomasum or ketosis were found to incur an additional 73.69%, 28.08% and 32.54% in costs respectively over those first-lactation animals reported as not having health problems. The equivalent costs for second-lactation animals were 17.99%, 11.79% and 13.00% respectively, while those for third-lactation animals were 21.71%, 12.51% and 15.02% respectively. For that same data set, average productive life estimates for animals culled for involuntary culling reasons, for mastitis, and for displaced abomasums were 35.59, 37.24 and 31.77 months respectively. Such lifetime profit measures will allow producers to more accurately evaluate the impact of health events on individual cow profitability and hence improve overall selection for profitability.

Key Words: lifetime, profitability, visualization

791 Stochastic economic evaluation of dairy farms' reproductive performance. A. S. Kalantari* and V. E. Cabrera, *University of Wisconsin-Madison, Madison.*

The objective of this study was to evaluate reproductive performance in dairy cattle under farms uncertain and variable conditions. Consequently, this study introduced stochasticity into a Markov chain model. A Markov chain model with 21 d stage length and 3 state variables—parity, days in milk, and days in pregnancy—was developed. Uncertainty was added to all main transition probabilities -involuntary culling, pregnancy rate, abortion risk, and milk production level- step by step to explore the effect of adding a single random variable at a time. Randomness was introduced in 1 of 2 ways: (1) using a polynomial regression model to build a white noise around the observed historical data for involuntary culling and abortion; and (2) using distributions -such as normal distribution for milk production levels and triangular distribution for pregnancy rates. The model was run for 10,000 replications after introducing each random variable. After verifying model's behavior, the model was run for 2,000 replications to study the effect of incrementing the 21-d pregnancy rates from 10 to 25% with one-unit-percentage intervals. An overall increase in the net return ($/cow per yr) from 10% 21-d pregnancy rate to 25% was observed. This marginal increment was greater at the lower pregnancy rates ($9 ± 6.8/cow per yr) and decreased to $5 ± 5.1/cow per yr in higher pregnancy rates. The reason for this difference among net returns of different reproductive performances was mainly due to the increment in the calf revenue and decrement in the culling and reproductive costs. There was a slight reduction in the overall milk revenue after increasing 21-d pregnancy rate, which was mainly due to the defined shapes of the milk lactation curves used in this study.

Key Words: Markov chain, stochastic, reproductive performance

792 A 50-year comparison of the environmental impact and resource use of the US swine herd: 1959 vs. 2009. R. A. Cady*[1], G. Boyd[2,3], L. Wittig[3], G. Bryan[4], P. J. Holden[5], A. L. Sutton[6], and D. Anderson[7], *[1]Elanco, Greenfield, IN, [2]Prasino Group, Topsail Beach, NC, [3]Camco, Broomfield, CO, [4]Camco, London, UK, [5]Iowa State University, Ames, [6]Purdue University, West Lafayette, IN, [7]Anderson Associates, Loveland, CO.*

Cradle-to-gate lifecycle assessments compared environmental impact and resource use of US swine production in 1959 to 2009. The functional unit is one kg of hot dressed carcass weight (HDCW). Boundaries were from crop sowing to market-ready hogs at the farmgate. A process-based deterministic model tracked yearlong pig flow through swine production. Age-sex subclass census were adjusted to account for mortality and live hog import/export. USDA-NASS, USDA-ERS and the 1959 Agricultural Census provided hog demographics, crop statistics, irrigation, and crop inputs. The 2006 NAHMS swine reports, NRC 10th Edition of Nutrient Requirements of Swine, and the 2011 National Life Cycle Carbon Footprint Study for US Swine provided hog management data. Emission factors came from ASAE and Ecovent. Annual feed requirements were estimated using era-typical diets. Water intake and manure excretion were estimated. Cropland requirements were estimated using yield and input data for pesticides, energy use, and irrigation. Land use was discounted for by-product feeds. Emission factors were obtained for hog production, cadaver disposal, cropping, feed processing and transport, manure handling, and energy use. Prediction of live hogs to market was within ±0.1% of actual. The 2009 carbon emissions (CO_2e) were within 10% of the livestock portion US National Swine Lifecycle report and fell within the 95% CI. Marketed hogs increased from 87,600,000 to 112,600,000 from a 39% smaller breeding herd. HDCW yield increased from 5.49 million metric tonnes (MMT) to 10.34 MMT; an increase of 1,012 kg of HDCW harvested per sow-year. Total feed increased 25% resulting in whole population feed conversion improving from 6.6 kg feed/kg HDCW to 4.4 kg/kg. Added gains in crop yields and by-product feed use led to a 59% decrease of land required resulting in a 78% decrease in land per kg HDCW. Annual animal water consumption increased from 123.6 billion L to 137.1 billion L. However, water consumption decreased from 22.5 L/kg HDCW to 13.3 L/kg. CO_2e emissions increased from 45.7 MMT to 56.1 MMT while kg CO_2e/kg HDCW declined 35% from 8.3 kg/CO_2e to 5.4 kg/CO_2e.

Key Words: carbon footprint, sustainability