M217 Measuring dry matter of corn silage, haylage, and TMR samples with a food dehydrator. R. J. Norell*[1], C. M. Matuk[2], S. Hines[2], M. Chahine[2], M. de Haro Marti[3], and S. C. Parkinson[4], *[1]University of Idaho, Idaho Falls, [2]University of Idaho, Twin Falls, [3]University of Idaho, Gooding, [4]University of Idaho, Preston.*

Quality control procedures for TMR feeding require on-farm measurement of dry matter for ensiled forages and prepared TMRs. Current on-farm tests require operator attentiveness during the drying process and moderate laboratory skills. In this study, we compared dry matter determinations with a food dehydrator (DEHY) against a laboratory oven (OVEN). The dehydrators were 500 Watt, Nesco brand, FD-60 with 4 trays and each tray had a fruit roll-up sheet. Temperature settings were 68 C for DEHY and 55 C for OVEN. In part 1, 4 dehydrators with 4 trays each were utilized. Single corn silage, haylage, and TMR samples were split into 16 subsamples for dry matter determination. Each feedstuff was run separately with 100g of each subsample placed on an individual tray. Tray weights were collected at 0, 2, 4, 6, and 8 h. Sample weights were stabilized at the 4 or 6 h weighing period. Data were analyzed as a randomized block design with repeated measures on the tray position. Dry matter did not differ between tray position for corn silage ($P = 0.15$), haylage ($P = 0.52$), and TMR ($P = 0.07$). In part 2, unique lots of corn silage, haylage, and TMR (12 each) were collected and split into 4 subsamples. Dry matter determinations were made in groups of 4 lots for each feedstuff and each lot was replicated 4 times (once in each dehydrator and once within each tray position). Dehydrator tray weights were collected at 0, 2, 4, 6, and 8 h. Oven dry matter determinations were collected after 24 h. Means were calculated from the 4 replicates and then used to compare OVEN versus DEHY measurements at 8 h with paired *t*-tests. Mean difference (OVEN-DEHY), SE_{diff}, and significance were: +1.11 ± 0.16%, $P < 0.001$; +0.84 ± 0.30%, $P = 0.02$; +0.65 ± 0.16%, $P < 0.001$ for corn silage, haylage, and TMR, respectively. OVEN dry matter contents were slightly higher than DEHY, possibly due to greater volatilization of VFA's or other compounds with the dehydrators. Sample dry matters were mostly stable after a 4 h drying time. We conclude that food dehydrators with fruit roll-up trays are an effective, reliable tool for on-farm determination of dry matter.

Key Words: on-farm testing, food dehydrator, dry matter

M218 Determining surface area of exposed silage on California dairy farms. D. Meyer[1], P. H. Robinson[1], P. L. Price[1], R. Rauch[1], and J. M. Heguy*[2], *[1]University of California, Davis, [2]University of California Cooperative Extension, Modesto.*

Ensiled forages (i.e., silage) are a key ingredient in California dairy rations, but they are also emitters of volatile organic compounds (VOC). Our objective was to evaluate silage structures (pile, bunker, drive-over) on California dairy farms to determine the number of structures simultaneously utilized per farm, as well as the exposed silage surface area of each structure. The San Joaquin Valley Air Pollution Control District (SJVAPCD) had proposed a VOC emission mitigation to restrict exposed surface area of silages to 199.7 m^2 if only one structure was open, or 399.5 m^2 if more than one structure was open, per dairy farm. Forages preserved in plastic bags were not examined because they are exempt from the SJVAPCD calculation of surface area exposure. Silage structures on 20 dairy farms were evaluated. Exposed silage surface area was determined by identifying geometric features, making appropriate measurements and calculating surface area. Number of cattle in each age group was obtained for most farms. An animal feed unit equivalent (AFU) calculation assumed coefficients for each animal group as: 1.0, lactating cows; 0.9, dry cows; 0.7, heifers 15 to 24 mo of age; 0.5, heifers 7 to 14 mo of age; and 0.2, heifers 4 to 6 mo of age. The silage structures consisted of winter cereal, corn and alfalfa. The number of structures open per farm was 2.2 (SD = 0.9) with a maximum of 4. All farms with only 1 silage surface exposed (n = 4) met the SJVAPCD surface area requirement, but 5 of 16 farms which had more than one exposed silage surface did not. Exposed silage surface area per farm was 27.7 to 738.2 m^2. Exposed surface area (m^2)/AFU was 0.01 to 0.28 with 4 of 16 farms having values > 0.10. Total AFU and exposed silage surface areas within farm did not correlate with exposed silage surface area ($r^2 = 0.32$), suggesting that AFU is not a substantive factor in the amount of exposed silage surface area needed at silage feedout. The variation in exposed surface area (m^2)/AFU among farms suggests opportunities to develop and implement management practices to reduce exposed silage surface area on commercial California dairy farms.

Key Words: silage, volatile organic compounds , regulations

M219 Comparison of two methods of collecting calf birthweights (BW) in dairy calves. N. M. Long* and J. F. Smith, *Department of Animal Sciences, University of Arizona, Tucson.*

The collection of calf BW in dairies in the US is not a common practice. Calf BW was collected on 3 dairies (2 Holstein and 1 Jersey herd) over a 6 week period. All calves BW were collected less than 2 h after birth. A total of 872 calves were weighed by both a spring scale (SP; Rubbermade Co., Huntersville, NC) and also a hooftape (HT, Calfscale BW Tape, Nasco, Fort Atkinson, WI) with both weights and sex recorded. The Proc GLM (SAS Institute Inc., Cary, NC) was used to estimate LS means for SP BW with sex of calf and also dairy. Calf SP vs HT BW was compared using the Proc Reg of SAS. Calf BW was also broken down into increments and SP vs HT BW were compared utilizing *t*-test. Bull calves had a heavier ($P < 0.001$) BW (kg) compared with heifer calves (36.7 ± 0.4, n = 450 vs 34.6 ± 0.4, n = 422, respectively). Dairy in which calves were born had a significant effect ($P < 0.001$) on calf BW (kg) (Dairy 1: 36.8 ± 0.4, n = 204; Dairy 2: 39.5 ± 0.2, n = 463; Dairy 3: 25.9 ± 0.4, n = 205). When SP calf BW was linearly regressed by HT BW there was a significant relationship ($P < 0.01$) with a R2 value of 0.91. The breakdown of calf BW and comparison of SP and HT BW are shown in Table 1. For calves less than 31.3 kg, the HF overestimated ($P < 0.001$) calf BW compared with SP. However, for calves that weighted between 31.3 to 44.9 kg there was no difference ($P \geq 0.104$) between SP and HT BW. For calves heavier than 44.9 kg, HT underestimated ($P = 0.022$) BW compared with SP. Collection of calf BW by SP or HF appears to be comparable for most calves, since most calves weigh between 31 to 45 kg, but caution should be utilized for light or heavy BW calves.

Table 1. Comparison of spring scale and hoof tape on birthweight determination (mean ± SEM)

BW, kg	n	Scale	Tape	*P*-value
<27.2	148	23.2 ± 0.2	24.6 ± 0.3	<0.001
27.2-31.3	95	28.9 ± 0.2	29.7 ± 0.2	<0.001
31.3-35.8	135	33.8 ± 0.1	34.0 ± 0.1	0.217
35.8-40.4	242	38.0 ± 0.1	37.8 ± 0.1	0.133
40.4-44.9	165	42.4 ± 0.1	42.2 ± 0.2	0.104
> 44.9	87	47.4 ± 0.3	46.5 ± 0.4	0.022

Key Words: dairy calves, birthweight, hoof circumference tape

M220 Assessing among-farm variability in heifer body weights. G. B. Bond*[1,2], M. A. G. von Keyserlingk[1], N. Chapinal[1], E. A. Pajor[2], and D. M. Weary[1], *[1]University of British Columbia, Vancouver, BC, Canada, [2]University of Calgary, Calgary, AB, Canada.*

Raising healthy young stock to be productive cows is crucial to a dairy farm, but indicators of successful heifer rearing, including weight gains, are rarely measured. Our aim was to describe the variation in growth of Holstein heifers reared on dairy farms in the lower Fraser Valley region of British Columbia. Data were collected by the same individual on 33 farms, all using the Dairy Herd Improvement (DHI) recording system and with a minimum milking herd of 100 cows. Farms were visited between June 2010 and October 2010. Heart girth circumference was measured for all heifers aged 12 to 17 mo (n = 560) and these values were converted to estimate body weight (BW). Birth dates were also recorded. Data were analyzed through a simple linear regression analysis resulting in a line equation of BW (kg) = 112.9 + 5.1* (age in weeks) ($R^2 = 0.35$). Residuals derived from this regression were averaged across heifers within each farm; these farm averages ranged from −53.8 to 71.5 kg. We tested the effects of a range of farm level descriptors (including weaning method, time between weaning and moving to a new pen, size of the heifer group, frequency of regrouping heifers, times per day heifers were provided fresh feed) but only one variable was able to account for among-farm variation in residual weights; average weight gain during the pre-weaning phase (i.e., calves 0 to 2 mo of age; residual gains measured as described above for heifers). Residual weights of heifers increased with gains of the pre-weaned calves (line equation: Residual Heifer BW (kg) = −1.50 + 2.99* Residual Calf BW (kg); $R^2 = 0.39$). These results show considerable among-farm variation in heifer weight gains, indicating that some farms are doing well while others could improve performance. Farms able to rear faster growing heifers were also rearing faster growing calves, suggesting that management of milk-fed calves is especially important.

Key Words: calf growth, milk feeding, welfare

M221 The effects of increased space allowance on dairy calf performance, behavior, and respiratory antibody production. M. S. Calvo*[1], L. E. Hulbert[1], A. Louie[2], L. J. Gershwin[3], K. E. Pinkerton[4], K. C. Klasing[1], C. B. Tucker[1], and F. M. Mitloehner[1], *[1]Department of Animal Science, University of California, Davis, [2]School of Veterinary Medicine, University of California, Davis, [3]Department of Pathology, Microbiology and Immunology, School of Veterinary Medicine, University of California, Davis, [4]Department of Anatomy, Physiology, and Cell Biology, School of Veterinary Medicine; Center for Health and the Environment; University of California, Davis.*

California dairy calves are typically raised individually in wooden hutches with a space allowance of 1.23 m^2/head. Because management and housing of livestock continues to be an important issue to both consumers and producers, the objective of the following research was to modify current calf housing systems to investigate the possible benefits of increasing space allowance. The 3 housing treatments were: 1) conventional housing (SML; 1.23 m^2/head; n = 18), 2) 1.5 x SML (MED; 1.85 m^2/head; n = 19), or 3) 3 x SML (LRG; 3.71 m^2/head; n = 20). Milk and starter intake were recorded daily and BW were measured on d 0, 20, 45, 73, and 87. Visual health assessment scores were recorded daily and behavior loggers were utilized on 21–31, 46–56, and 74–84 d to assess the effects of treatments on health and resting behavior over the 87 d study period. In a sub-experiment, healthy calves from each treatment (n = 6, SML; n = 8, MED; n = 7, LRG) were sensitized (subQ) and challenged (aerosolized) with Ovalbumin (OVA) at age 76 ± 0.5 d. Broncho-alveolar lavage fluid (BALF) was collected at age 80 ± 0.5 d and was analyzed for OVA-specific IgG, IgG1, IgA, and IgE. Calves in MED and LRG had greater body weights and average daily gains by 45 d of age ($P < 0.05$). A greater percentage of days with clean hide scores were observed in LRG calves ($P < 0.05$). Although there were no differences across treatments in clinical symptoms of respiratory illness, MED calves had less BALF OVA-IgE compared with SML and LRG ($P < 0.05$). As SML and MED calves grew, they spent less time in the standing-position ($P < 0.05$), but LRG calf standing time stayed the same ($P > 0.10$). Early in life (age 21–23 d), all calves spent 16.6 ± 0.31 h/d in resting-position ($P > 0.10$). Calves in SML and MED hutches increased resting time as they aged (47–49, 74–76 d; $P < 0.05$), but LRG calf resting time did not change over time. Although maximizing space allowance in wooden hutches provides more room for calves, a moderate increase in space allowance may be more beneficial to calf performance, resting time, and respiratory antibodies.

Key Words: bovine, performance, behavior

M222 Growth measurements of organically raised dairy steers compared with conventionally raised dairy steers. E. A. Bjorklund* and B. J. Heins, *University of Minnesota, West Central Research and Outreach Center, Morris*

Bull calves (n = 50) were used to compare growth measurements of conventional and organic dairy steers. Calves were assigned to one of 3 groups at birth: conventional (CONV, n = 16), organic (ORG, n = 17), and organic-grass only (GRASS, n = 17), and were born at the University of Minnesota West Central Research and Outreach Center, Morris from March to May 2011. Breed groups of calves were: Holstein (n = 10), Holsteins (n = 11) maintained at 1964 breed average level, and crossbreds (n = 29) comprised of Holstein, Swedish Red, Montbéliarde, and Jersey. The CONV steers were fed a diet of 80% concentrate and 20% roughage and received steroidal implants. The ORG steers were fed a diet of organic corn, organic corn silage, and at least 30% of their diet consisted of organic pasture during the grazing season. The GRASS steers grazed pasture during the grazing season and were fed high quality hay or hay silage during the non-grazing season. Diets fed were recorded daily with herd management software. Body weight was recorded at birth, weaning, and monthly. Hip height, heart girth and body condition score were measured at weaning and monthly thereafter. Analysis was with PROC GLM of SAS, and independent variables for statistical analysis were the fixed effects of steer group and breed group. For the first 9 mo of age, steer performance was: total gain (kg), CONV (324), ORG (227), GRASS (146), ($P < 0.01$), and average daily gain (kg/d); CONV (1.12), ORG (0.79), and GRASS (0.51), ($P < 0.01$). From weaning (90 d) to 9 mo of age, performance was: total gain (kg) CONV (255), ORG (157), and GRASS (89) ($P < 0.01$), and average daily gain (kg/d), CONV (1.31), ORG (0.81), and GRASS (0.46), ($P < 0.01$). Hip height gain (cm) (CONV, 21.8; ORG, 15.1; GRASS, 6.7) and heart girth gain (cm) (CONV, 39.0; ORG, 21.5; GRASS, 14.2) from weaning was different ($P < 0.01$) for all steer groups. Furthermore, body condition score was different ($P < 0.01$) for all steer groups (CONV, 3.96; ORG, 3.40; GRASS, 3.01). No significant differences were found for breed groups for growth measurements.

Key Words: organic, grass-fed, dairy steers

M223 Associations between herd-level feeding management practices, feed sorting, and milk production in freestall dairy farms. A. D. Sova*[1], S. J. LeBlanc[2], B. W. McBride[3], and T. J. DeVries[1], *[1]Dept. of Animal and Poultry Science, University of Guelph, Kemptville Campus, Kemptville, ON, Canada, [2]Dept. of Population Medicine, University of Guelph, Guelph, ON, Canada, [3]Dept. of Animal and Poultry Science, University of Guelph, Guelph, ON, Canada.*

Challenges associated with group housed dairy cows include within-herd variability in nutrient consumption and milk production, which may be related to feeding management. The objective of this study was to examine the association of herd-level feeding management factors, feed sorting, and milk production. Ten free-stall herds, with average lactating herd size of 106 ± 26 cows, feeding TMR were studied for 7 consecutive days. Milk production parameters, including yield, fat, and protein, were recorded through a DHI test occurring ± 3 d of the study. A survey of feeding management practices and barn characteristics was administered on each farm. Amount of feed offered and refused was recorded and sampled daily to assess DM and particle size distribution. The particle separator had 3 screens (19, 8, 1.18 mm) and a bottom pan, resulting in 4 fractions (long, medium, short, fine). Sorting was calculated as the actual intake of each particle fraction expressed as a % of its predicted intake. Sorting values > 100% indicate selection for, while values < 100% indicate sorting against. Data were summarized across each 7-d period for each farm and analyzed in multivariable mixed-effect regression models. Categorical variables included in the models were milking frequency (MF; 0 = 2x/d; 1 = 3x/d) and feeding frequency (FF; 0 = 1x/d; 1 = ≥ 2x/d). Greater milk yield was associated ($P < 0.04$) with herds of lower average DIM, which milked 3x/d and fed ≥ 2x/d; milk yield (kg/d) = −0.06(SE = 0.02) × DIM + 3.5(SE = 1.2) × MF + 3.0(SE = 1.1) × FF + 40.8(SE = 3.2). Greater DMI was associated ($P < 0.02$) with herds of greater average parity, which fed ≥ 2x/d; DMI (kg/d) = 6.5(SE = 1.9) × parity + 4.1(SE = 1.1) × FF + 7.4(SE = 4.4). Higher milk fat % and less sorting against long ration particles were associated ($P < 0.03$) with herds of greater average DIM, which fed ≥ 2x/d; milk fat (%) = 0.005(SE = 0.001) × DIM + 0.3(SE = 0.1) × FF + 2.6(SE = 0.3); sorting of long particles (%) = 0.07(SE = 0.02) × DIM + 4.7(SE = 1.3) × FF + 81.0(SE = 3.0). The results suggest that herd-level feeding management practices to promote feed access, such as increased feeding frequency, may be used to improve DMI, reduce sorting, and improve milk yield and fat percentage.

Key Words: feeding management, sorting, milk production

M224 Comparison of the effects of conductive cooling to fan cooling on lactating dairy cattle. R. B. Thornton*[1], W. A. Greene[1], J. Bruer[2], and T. Steele[2], *[1]The Ohio State University, Wooster, [2]Conco Technologies, Chandler, AZ.*

The objective of this study was to compare physiological effects of conductive cooling (COND) to fan cooling (FANS) on lactating dairy cattle for 12 wk during the summer (June–August) of 2011 in northwest Ohio. Cows, milked 3x/day, were housed in a sand-bedded 6-row barn configuration with 122 cm fans at 12.2 m intervals over the feed aisle and free-stalls, programmed to operate at temperatures above 15.6°C. Seventy cows were paired for parity, DIM, and milk yield. Thirty-five cattle were housed in one section of the barn where fans were disabled and heat exchangers were buried 30.5 cm below the bed in the 33 freestalls (COND). Well water (12.5 to 18.1°C) was pumped through the heat exchangers. The other (paired) 35 cows were a part of an 114-cow group that had 107 freestalls with operating fans (FANS). Milk weights, milk components, and SCC were recorded for the paired cows. At the start of the trial, COND and FANS cows had similar ($P > 0.05$) least squares means (LSM) for average daily energy-corrected milk (ECM) weights (43.0 ± 1.5 vs. 42.8 ± 1.5 kg) and SCC (28,030 ± 4,416 vs. 23,969 ± 4,485 cells/mL). The percent of cows resting in each group was observed weekly at approximately 1100. Midday rectal temperatures and respiratory rates were randomly measured weekly on 15 cows in each housing group. Hourly ambient temperature and humidity measurements were recorded and thermal-humidity indexes (THI) were calculated throughout the trial. Daily average THI ranged from 62.4 to 81.7. COND and FANS cows had similar ($P > 0.05$) LSM for average daily ECM (37.8 ± 0.8 vs. 37.7 ± 0.8 kg) and SCC (36,626 ± 23,244 vs. 87,772 ± 23,191 cells/mL) during the 12 wk trial, although SCC tended to be higher for the FANS group from wk 8 to 12. There was no difference ($P > 0.05$) in LSM for average percent of cows observed resting between the COND (50.3) and FANS (50.6) groups. COND and FANS cows had similar ($P > 0.05$) LSM for average rectal temperatures (38.7 vs. 38.6°C) and respiratory rates (67.8 vs. 67.6/min). In general, there were no differences observed between the 2 methods of cooling lactating dairy cattle.

Key Words: cow cooling, heat stress

M225 Effect of FlipFan cooling system on lactating dairy cattle performance in an open dry-lot commercial dairy in a sub-tropical environment in central Texas. J. A. Hernandez-Rivera*[2], F. D. Alvarez-Valenzuela[2], U. Macias-Cruz[2], L. Avendano-Reyes[2], and T. R. Bilby[1], *[1]Texas AgriLife Research and Extension Service, Texas A&M System, Stephenville, [2]Instituto de Ciencias Agricolas, Universidad Autonoma de Baja California, Ejido Nuevo Leon, Valle de Mexicali, Mexico.*

Heat stress negatively affects dairy cattle performance, thus adequate cooling strategies are needed. Objective of the current study was to evaluate the effect of a new cooling system on production and physiological parameters during a 4 d period in summer. Twenty-four multiparous cows balanced for DIM, parity, and daily milk production were assigned to 1 of 3 treatments: H (control Holstein group with shade only; n = 8); FF-H (Holstein cows cooled with Flip Fan cooling system plus shade; n = 8), and JxH (control Jersey x Holstein crossbred group with shade only; n = 8). All groups were cooled before milking at 1100 and 2300 h with sprinklers and fans in the holding pen. The cooling system (Schaefer FlipFan) was placed on the south edge under the shade approximately 4 m from the ground, and consisted of 33 fans, that could rotate 180° and high pressure misters fixed to the front of the fans which followed the movement of the shade. The FlipFan system ran continuously throughout the duration of the study. Skin temperatures (ST) of the hip region (30.2 vs. 32.0 and 33.1°C), right flank (30.6 vs. 32.6 and 33.1°C), udder (31.3 vs. 32.7 and 33.4°C) and head (28.5 vs. 30.2 and 31.9°C) in the morning were lower ($P < 0.05$) in FF-H versus H and JxH cows, respectively. During the afternoon, ST of the hip, right flank, udder, and head were lower ($P < 0.05$) in FF-H cows (34.9, 34.7, 35.1 and 33.6°C, respectively) compared with H (38.5, 38.3, 38.8 and 39.3°C, respectively) and JxH (37.2, 37.2, 37.9 and 38.2°C, respectively). During the morning and afternoon, the respiration rate per minute (rpm) in H (74 and 111 rpm) and JxH (84 and 112 rpm) groups were greater ($P < 0.05$) than in FF-H (61 and 88 rpm) group. In addition, H group core body temperature peaked at 40.9°C, whereas both JxH and FF-H groups were lower and peaked at 40.5 and 40.0°C, respectively. The FlipFan cooling system reduced heat stress effects by reducing ST, respiration rate and core body temperature in lactating Holstein dairy cattle.

Key Words: dairy cow, heat stress, cooling

M226 Correlation between invasive methods for recording physiological parameters and infrared thermography in calves. P. A. B. Mac-Lean[1], H. Savastano Junior[1], L. C. Roma Junior*[2], S. Correa[1], C. N. Barra[1], C. G. Titto[1], and C. E. L. Oliveira[1], *[1]University of Sao Paulo, Pirassununga, Sao Paulo State, Brazil, [2]APTA Centro Leste, Ribeirao Preto, Sao Paulo State, Brazil.*

Evaluation of physiological parameters such as temperature have been used as indicators of heat stress. Human intervention and proper restraint are usually necessary to measure these physiological parameters; therefore, the development of a tool that avoids interference would be desirable. The objective of this study was to compare measurement of physiological parameters (traditional method) with infrared thermography (non-invasive method). Twenty Jersey and crossbred suckling calves were used in the study for a period of 5 d with an interval of 6 h between each measurement, totaling 400 measurements per variable. Variables analyzed were rectal temperature, ear temperature, coat surface temperature, in addition to infrared thermography (IRT) of auricular, dorsal and caudal regions. A randomized block design balanced for sex and breed was used. Data were analyzed using the Proc GLM, Proc Corr and Proc Reg of SAS. The correlations between IRT and coat surface temperature, ear temperature and caudal region temperature were 0.88, 0.86 and 0.75, respectively. Ear temperature by IRT showed the best correlation with traditional method for rectal temperature (0.69; $P <$ 0.001). Thus, the regression for other physiological parameters used ear temperature recorded by IRT as the dependent variable. The coefficients of determination provided with regression were 0.53, 0.73, 0.62 and 0.47 for coat surface temperature, ear temperature, caudal region temperature and rectal temperature, respectively. It appears from these results that infrared thermography could be used to estimate physiological indicators of heat stress with minimal interference. Financial support by FAPESP, process 10/07978-8.

Key Words: physiological variables, thermoregulation, thermal imaging

M227 Agreement between reticular and vaginal measurement of core temperature in dairy cattle. J. A. Small[1,2], R. Hayman[2], T. Rudderham[2], A. Fredeen[2], and W. Webster*[3], *[1]Agriculture and Agri-Food Canada, Truro, NS, Canada, [2]Nova Scotia Agricultural College, Truro, NS, Canada, [3]DVM Systems LLC, Denver, CO.*

Agreement between reticular and vaginal measurements of core temperature (Tc) in dairy cattle was determined using fistulated lactating dairy cattle (n = 4) in good body condition (BCS 2.5 to 3.0) A prototype hand-held reader was used to capture reticulo-rumen temperatures (Trr) from passive transponder boluses containing thermistors that were placed in the reticulum (DVM Systems, LLC, Denver CO). A digital thermometer was used to determine vaginal temperatures (Tv). Cattle were offered 68 L of either warm (39°C) or cold (12°C) fresh drinking water at 0600 and 1700, in a crossover design. Starting at 0420 and 1517, Tc were taken at intervals relative to free water intake (FWI) −105, −90 (before milking) −60, −45 (milking), −30, −15 (after milking), 05, 10 (FWI) and 15, 30, 45, 60, 75, 90 min (post-FWI). Cattle were housed in tie-stalls exposed to barn lights from 0400 to 1800 and natural light, full-fed a total mixed ration (33% dry matter) offered at 0530, 0830, 1030, 1400, and moved to an exercise yard from 0730 to 0830. The barn temperature-humidity index ranged from 45 to 51. To determine agreement between Tv and Trr the average of the 3 previous Tc were deemed the baseline to calculate the deviation of the current value from baseline. Agreement between Trr and Tv was fair overall observations (kappa = 0.23; $P < 0.01$; n = 333), moderate before FWI (kappa = 0.57; $P < 0.01$; n = 96), and substantial when measurements were taken before FWI in the morning (kappa = 0.71; $P < 0.01$ n = 56) and fair (0.37; $P = 0.02$) in the afternoon. The predicted change in Trr at each time after FWI was dependent upon FWI temperature and volume. Predicted Trr decreased −4 to −9°C at 10 min after drinking 2 to 70 L of cold water and regardless of volume remained 3°C below baseline after 60 min. The predicted change in Tv at each time after drinking water was dependent upon the temperature and volume of FWI until 60 min after drinking. However, in contrast to Trr, small volumes of cold water caused a transient decrease in Tv and larger volumes increased Tv 0.2°C. In dairy cattle FWI influenced Trr and Tv, and the most accurate measurements were obtained in the morning before milking and FWI.

Key Words: reticular temperature, drinking water, dairy cattle

M228 Warm drinking water lowers core temperature in dairy cattle. J. A. Small[1,2], T. Rudderham[2], R. Hayman[2], A. Fredeen*[2], and W. Webster[3], *[1]Agriculture and Agri-Food Canada, Truro, NS, Canada, [2]Nova Scotia Agricultural College, Truro, NS, Canada, [3]DVM Systems LLC, Denver, CO.*

Fistulated lactating dairy cattle (n = 4) in good body condition (BCS 2.5 to 3.0) were used in a crossover design to determine the effects of warm free water intake (FWI) on core temperature. Cattle were offered 68 L of either warm (W; 39°C) or control (C; 12°C) drinking water twice daily at 0600 and 1700. Each period consisted of 7 d adaptation to treatment followed by 2 consecutive days of data collection. A prototype hand-held reader was used to capture reticulo-rumen temperature (Trr) from passive transponder boluses containing thermistors that were placed in the reticulum (DVM Systems LLC, Denver CO). A digital thermometer was used to determine vaginal temperature (Tv). Core temperatures taken at intervals starting at 0420 and 1517 were deemed pre-milking (−105, −90 min); milking (−60 and −45 min), post-milking (−30 and −15 min), FWI (05 and 10 min) and post-FWI (15, 30, 45, 60, 75, 90 min). Cattle were housed in tie-stalls exposed to barn lights from 0400 to 1800 and natural light, full-fed a total mixed ration (33% dry matter) offered at 0530, 0830, 1030, 1400, and moved to an exercise yard from 0730 to 0830. The barn temperature-humidity index ranged from 45 to 51. Data were subjected to Proc Mixed procedures for a cross over design with repeated measures (morning and afternoon). Mean milk yields were greater ($P < 0.05$) and mean FWI were less ($P = 0.10$) for morning than afternoon, and did not differ ($P > 0.20$) between W and C (41.9, 50.0 and 39.5, 48.1 ± 8.4 L FWI, respectively). Pre-milking, morning and afternoon Trr and Tv means for W and C were 38.7, 38.7 and 38.8, 38.9 ± 0.24°C, and 38.5, 38.6 and 38.5, 38.8 ± 0.07°C, respectively. Post-milking, morning and afternoon Trr and Tv means were 0.2, 0.4°C and 0.1, 0.3°C lower ($P < 0.05$) for W than C, respectively. After FWI, morning and afternoon Trr means were higher ($P < 0.05$) and Tv similar ($P > 0.29$) for W than C (38.7, 38.2, and 31.9, 30.6 ± 0.24°C, and 38.5, 38.7 and 38.4, 38.7 ± 0.07°C), and 90 min later were 1.4, 0.9°C and 0.1, 0.3°C higher for W than C, respectively. In conclusion, warm FWI caused a transient increase in core temperature, but had the net effect of lowering basal core temperature especially in the afternoon.

Key Words: reticular temperature, drinking water, dairy cattle

M229 Influence of time of day, breed, and season on reticulorumen temperature in lactating dairy cows. D. Liang,* D. L. Ray, J. D. Clark, and J. M. Bewley, *University of Kentucky, Lexington.*

The objective of this research was to characterize the influence of time of day, breed, and season on reticulorumen temperatures in lactating dairy cows. Reticulorumen temperatures (RT) were recorded every 15 min using SmartBolus transponders (TenXsys Inc., Eagle, ID) for 103

cows (68 Holstein, 25 crossbred and 10 Jersey) at the University of Kentucky Coldstream Dairy from November 06, 2009 to July 24, 2011. Air temperatures (AT) were collected every 15 min on location with a SmartBolus transponder. Raw RT (n = 1,646,145) were edited to remove erroneous reads and temperatures potentially influenced by water intake by removing any RT lower than 38.33°C. The mean (±SD) RT among the remaining 927,048 temperatures was 40.16 ± 0.52°C. Peak and nadir mean RT occurred at 23:45 (40.26°C) and 10:00 (39.92°C), respectively. Mean (±SD) AT was 14.75 ± 10.55°C. The MIXED procedure of SAS (Cary, NC) was used to assess the impact of breed and season on RT. The CORR procedure of SAS was used to calculate correlation coefficients between RT and AT. The reticulorumen temperature was lowly correlated with AT (r = 0.28, $P < 0.01$). Least squares means (LSM) Holstein RT (40.16 ± 0.01°C) were higher ($P < 0.01$) than crossbred RT (40.07 ± 0.01°C) while Jersey RT (40.09 ± 0.03°C) were not significantly different from Holstein RT or crossbred RT. Summer RT (40.24 ± 0.02°C) were higher than spring RT (40.08 ± 0.01°C), fall RT (40.09 ± 0.03°C) and winter RT (40.03 ± 0.02°C) ($P < 0.01$). In the spring, Holstein RT were higher than Jersey RT ($P < 0.01$) and crossbred RT ($P < 0.01$), with no significant differences observed between Jersey RT and crossbred RT. In the summer, Holstein RT were higher than crossbred RT ($P < 0.01$) and crossbred RT and Holstein RT were higher than Jersey RT ($P < 0.01$). In the fall, crossbred RT were higher than Holstein RT ($P < 0.01$) with no other significant differences among breeds observed. In the winter, Jersey RT were higher than Holstein RT ($P < 0.01$) and crossbred RT ($P = 0.02$) and Holstein RT were higher than crossbred RT ($P = 0.02$). These results may be useful in interpreting differences in RT obtained across varying seasons and breeds.

Key Words: reticulorumen temperature, season, breed

M230 Udder skin temperature of dairy cows under heat stress and physiological parameters tested by infrared thermography in two cooling system conditions. R. B. Younes[1,3], G. Licitra[2,3], G. Azzaro[2], I. Schadt[2], M. Caccamo*[2], R. Petriglieri[2], and S. Carpino[2], *[1]Institut National Agronomique de Tunisie, Tunis, Tunisia, [2]CoRFiLaC, Regione Siciliana, Ragusa, Italy, [3]DISPA, Catania University, Catania, Italy.*

Obtaining internal temperature is difficult under practical farm management conditions and requires animal restraint. An alternative might be to directly measure animals′ surface temperature. In this study infrared thermography was used to measure udder skin temperature. Thermal stress can adversely affect milk yield and milk composition. Our primary objective was to examine how udder temperature, as a measure of core body temperature, is affected by environmental conditions; moreover we aimed to assess the effects of test day, stage of lactation and 2 different cooling systems, Sprinkler system (SP) and Shower system (SH), on physiological parameters. Twenty Holstein cows were split into 2 treatment groups, SH and SP and within each treatment had additional ventilation. Cows were assigned to 2 treatments of 10 animals with similar average days in milk (DIM), milk production and milk composition. Respiration rates (RR), rectal temperature (RT) and udder skin temperature (UST) were measured, each time, between 3 and 5:30 p.m. Individual milk samples were measured 6 times, with 15-d intervals, beginning at the end of June and analyzed for fat, protein and lactose content. At each test day, ambient temperature, relative humidity and THI were calculated. THI values at test d 1 through 6 were 73.3, 79.7, 77.8, 74.1 and 72.3, respectively. Udder skin temperature was significantly affected by test day ($P \leq 0.001$). Measured RT and RR (LSMeans ± SE) in SH were 39.3 ± 0.1 and 61.2 ± 1.6, respectively and in SP were 38.9 ± 0.1 and 53.9 ± 1.6, respectively. Udder skin temperature, milk yield, fat protein and lactose (%) were not different between treatments ($P \geq 0.05$). These parameters were only affected by test day ($P \leq 0.001$). Relative humidity with SH might be higher compared with SP and might have increased heat stress of dairy cows. In conclusion, RT and RR were more sensitive than the udder skin temperature, measured by infrared, to detect core body temperature during heat stress. More work, on different milk parameters, would be necessary to better understand the infrared application in measuring udder surface temperature.

Key Words: infrared thermography, udder skin, cooling system

M231 Establishing the summer:winter ratio to evaluate the effects of heat stress on conception rates in US commercial dairies. H. M. Robertson*[1,2] and T. R. Bilby[2], *[1]Department of Animal Science and Wildlife Management, Tarleton State University, Stephenville, TX, [2]Texas AgriLife Research and Extension, Texas A&M System, Stephenville.*

Objective was to utilize conception rates (CR) to establish a summer:winter ratio (S:W) to determine the severity of heat stress on US dairies. Records for 684 dairies totaling 767,768 lactating cows were collected from Dairy Herd Improvement Association and Reproductive Program Management software (Genex Cooperative Inc.). The average CR for 3 summer months (Jul.-Sep. 2010) was divided by the average CR of 3 winter months (Jan.-Mar. 2011) to obtain the S:W ratio. Effects of herd size (small < 500 cows, medium 500–1000 cows, large > 1000 cows), facility type (drylot vs. freestall), US region (north vs. south), and breed (Holstein vs. crossbred and Jersey) on the S:W ratio were analyzed. There was no difference between breeds (Holstein; 0.69 vs. crossbred and Jersey; 0.70). A main effect ($P < 0.05$) of US region (north: 0.89 vs. south: 0.51 ± 0.02), facility (drylot: 0.73 vs. freestall: 0.66 ± 0.25), and dairy size (small: 0.64 vs. medium: 0.71 and large: 0.74 ± 0.03) was observed. However, there was an interaction ($P < 0.01$) between US region and dairy size with small and medium-sized dairies in the north having an increased S:W ratio vs. large dairies (0.88, 0.93 vs. 0.84 ± 0.03), whereas in the south, small and medium-sized dairies had a smaller S:W ratio than larger dairies (0.40, 0.48, vs. 0.64 ± 0.02). Herds were further separated into the top and bottom 10% for S:W ratio by US region. The top herds in the north (n = 42) and south (n = 18) had a S:W ratio of 1.12 and 0.97 ± 0.01, respectively. The bottom herds in the north (n = 42) and south (n = 18) had a S:W ratio of 0.56 and 0.25 ± 0.01, respectively. An interaction ($P < 0.01$) between US region and herd ranking was observed with dairies in the north having smaller difference in S:W ratio between top and bottom herds compared with dairies in the south (1.12, 0.56 vs. 0.97, 0.25 ± 0.01). There was no effect of breed. Our results indicate that facility type, dairy size and US region can affect S:W ratio. In addition, top dairy herds have almost eliminated the summer decline in CR whereas bottom herds have a 44 - 75% reduction in CR due to heat stress.

Key Words: heat stress, dairy, summer:winter ratio

M232 Utilizing production parameters to establish the summer:winter ratio to evaluate the effects of heat stress on commercial dairies in the southwest. H. M. Robertson*[1,2] and T. R. Bilby[2], *[1]Department of Animal Science and Wildlife Management, Tarleton State University, Stephenville, TX, [2]Texas AgriLife Research and Extension Service, Texas A&M System, Stephenville.*

Objective was to utilize pregnancy rate, conception rate, and standardized 150 d milk production (STMLK) to establish a summer:winter ratio (S:W) for evaluating the severity of heat stress on dairies in the

southwest. Records for 124 dairies totaling 192,765 lactating cows were collected from Dairy Herd Improvement Association and Reproductive Program Management software (Genex Cooperative, Inc.). The average conception rate, pregnancy rate and STMLK for 3 summer months (Jul.-Sep. 2010) were divided by the average of 3 winter months (Jan.-Mar. 2011) to obtain a S:W ratio for each. Effects of herd size (small < 700 cows vs. large > 700 cows), facility type (drylot vs. freestall), SW region (central, east, south and west), breed (Holstein vs. crossbred and Jersey) and reproductive management (bull vs. AI) on each S:W ratio were analyzed. There was no effect of any variables analyzed on S:W ratios for STMLK and conception rate. There was an effect of herd size ($P < 0.01$) and region ($P < 0.01$) with small herds having a lower S:W pregnancy rate ratio compared with large herds (0.42 vs. 0.62 ± 0.07) and herds in the west having a greater S:W pregnancy rate ratio compared with central, east and south (1.0 vs. 0.45, 0.42, 0.20 ± 0.1, respectively). Herds were further separated into the top and bottom 20% for both STMLK (1.08 and 0.86 ± 0.01) and pregnancy rate (0.71 and 0.23 ± 0.05) S:W ratio. The top 20% of the herds (n = 19) for STMLK S:W ratio also had a greater S:W pregnancy rate ratio compared with bottom herds (n = 18; 0.68 vs. 0.24 ± 0.08). In addition, the top S:W pregnancy rate ratio herds had an increased ($P < 0.01$) S:W STMLK ratio compared with bottom herds (1.02 vs. 0.96 ± 0.02). In conclusion, STMLK is reduced 22% and pregnancy rate 48% from the top versus bottom ranking herds. Also, herds which maintained an increased STMLK during summer also maintained a greater reproductive performance during summer. The top ranked herds evaluated still lost 29% of their pregnancy rate during summer whereas bottom herds lost 77%.

Key Words: heat stress, dairy, summer:winter ratio

M233 Heat stress effects on milk production and udder health in Holstein and Jersey cows. D. L. Smith, S. H. Ward,* T. Smith, and B. J. Rude, *Department of Animal and Dairy Sciences, Mississippi State University, Mississippi State.*

The objectives of this study were to: 1) investigate effects of heat stress and breed on milk and component yield for Holstein and Jersey cows on the same farm and 2) determine the effects of breed on udder health as measured by somatic cell count during times of heat stress. Data were collected from DHIA records from the Bearden Dairy Research Center at Mississippi State. After the removal of duplicates, 16,429 individual monthly records from 1997 to 2010 pertaining to Holstein and Jersey cows were used. Measures taken from the monthly records were: yield, milk fat percentage, milk protein percentage, and SCC. Milk yield (MY) and milk fat percentage were used to calculate 4% fat corrected milk (FCM). Climatological data were obtained from the National Weather service station located at the Golden Triangle Regional Airport (GTR) and the weather station operated by the Department of Geosciences on the campus of Mississippi State University (MSU). The weather measurements included, maximum and minimum temperature, along with maximum and minimum relative humidity. Any missing weather measurements were obtained from the National Weather Service station located at the Columbus Air Force base near Columbus, Mississippi. Maximum and minimum ambient temperature and relative humidity were determined from hourly data for each 24-h period and were used to calculate THI. Effects of THI, breed, and the interaction were analyzed using PROC MIXED (SAS Institute, 2009). The dependent variables were test day milk yield and milk components, SCC, and FCM. The model included fixed effects for combined THI (t), breed (b), and breed x THI, with DIM (d) as a covariate. All main effects were tested along with all interactions. Milk yield and FCM decreased during heat stress in Holsteins (34.2 vs. 32.9 kg/d, $P < 0.01$) and was not different in Jerseys (24.7 vs. 25.8 kg/d, $P < 0.20$). Heat stress affected somatic cell count although effects varied by intensity of heat stress. Breed did not have an effect on somatic cell count. Milk fat and protein percentages declined for both breeds in heat stress conditions. Milk fat but not milk protein of Jersey cows increased as stress increased from mild to severe. During heat stress and cool conditions Holstein cows had reduced FCM from 35.7 kg to 33.6 kg ($P < 0.05$) while Jersey did not differ. From mild heat stress to moderate Jersey FCM did not differ from 27.1 kg/d to 25.7 kg/d, respectively ($P > 0.05$) but was reduced to 23.7 kg/d when THI exceeded 90. FCM in Holsteins decreased during mild, moderate and severe heat stress from 34.8 kg/d to 32.8 kg/d and 30.9 kg/d, respectively. During heat stress, total MY in Holstein cows remained greater than in Jerseys, however, MY in Jersey cows was not affected by increased THI.

Key Words: dairy cows, heat stress, milk production

M234 Impact of season on the metabolic profile in transition Holstein dairy cows in summer and winter. K. J. Lager*[1,2], E. R. Jordan[1], R. G. S. Bruno[1,2], J. A. H. Rivera[3], R. Sprowls[4], and D. R. Topliff[2], *[1]Texas AgriLife Extension Service, Texas A&M System, College Station, [2]West Texas A&M University, Canyon, [3]Texas AgriLife Research, Stephenville, [4]Texas Veterinary Medical Diagnostic Laboratory, Amarillo.*

The objective of this study was to determine differences on an extensive metabolic profile between seasons of transition Holstein dairy cows with current genetics and dairy management strategies. Blood samples were collected in summer (n = 1787) and winter (n = 1871) from Holstein cows within the transition period via coccygeal vessel venipuncture in nonheparinized vacuum blood tubes at morning feeding on 8 commercial dairies. One day per dairy was utilized to collect blood samples for cows within the transition period and the same dairies were sampled for both time periods. Following centrifugation, samples were stored frozen (−20°C) in duplicate before laboratory analysis for calcium, phosphorus, magnesium, albumin, urea, glucose, cholesterol, sodium, potassium, chloride, and nonesterified fatty acids. Weather data was collected for the 2-week period before sample collection. Herd records were reviewed to identify data points from cows experiencing dystocia, retained placenta, displaced abomasum, twin births, stillbirths and cows being dry <30d or >80d and data were analyzed using multiple regression in SAS. Seasonal effects were shown ($P < 0.05$) for all parameters exclusive of Na. Designating 3 d before 3 d post calving as week zero with 7 d intervals radiating from zero, analysis revealed that week relative to calving had an effect ($P < 0.05$) on serum P, Mg, glucose, cholesterol, NEFA, Na, K, and Cl levels. However, the effects of health parameters were limited to Ca, Cl, and albumin. Dry period length was also shown to affect ($P < 0.05$) profile parameters including P, albumin, glucose, cholesterol, NEFA, and K. Based upon these results reference values utilized for metabolic profile analysis may benefit by taking into account seasonal variation.

Key Words: dairy cow, metabolic profile, transition period

M235 Abundance of antibiotic resistance genes in the gut and feces of ionophore-fed lactating cows. T. Galligan,* P. P. Ray, A. Pruden, and K. F. Knowlton, *Virginia Polytechnic Institute and State University, Blacksburg.*

The contribution of dairy cattle to the global pool of antibiotic resistance genes (ARG) is a growing concern. The use of ionophores or subtherapeutic doses of other antimicrobials may select for antibiotic-resistant bacteria, contributing to the ARG reservoir in the cow gut. Improved knowledge

of the establishment of ARG in the gut and feces would support assessment of the contribution of dairy cattle to the environmental pool of ARG. The objective was to evaluate the effect of ionophores on the abundance of ARG in ruminal fluid, ileal digesta, and feces of lactating cows. Five lactating dairy cows were examined in a crossover design over 2, 30-d periods. Cows were fed diets with and without the ionophore monensin (320 mg/d). Cows in the study were exposed to oxytetracycline in milk replacer as calves but had no history of exposure to sulfonomides or erythromycin. On d 30 of each period, ruminal, ileal, and fecal samples were collected and subjected to DNA extraction. Six common ARG were subsequently analyzed by quantitative polymerase chain reaction: *tet*W, *tet*G, *tet*X, *tet*O, *sul*1, and *erm*F, encoding resistance to tetracyclines, sulfonomides and erythromycin, respectively. The effects of site (rumen, ileum, feces) and ionophore feeding on absolute and relative abundance of the ARG were analyzed using PROC GLIMMIX procedure in SAS. All 6 ARG were detected in all samples. *Tet*W was the most abundant ARG in all sample types, followed by *tet*O. Absolute abundance (log gene copies/g wet sample) of each ARG was similar in rumen and ileal samples but lower ($P < 0.10$) in fresh feces. Relative abundance (gene copies/16s rRNA) was similar among the rumen, ileum, and feces. Monensin did not affect absolute or relative abundance of any ARG at any sampling site. The ARG were present in the digestive tract before the cows were exposed to monensin, suggesting that monensin is not a driver of the cow gut ARG reservoir. Therefore, simply removing these antibiotics from the diet will not reduce the global ARG pool. Other management strategies must be evaluated to reduce ARG contribution from dairy cattle.

Key Words: antibiotic resistance gene, ionophore, dairy cow

M236 Production and management consequences of abortion in dairy herds of central Mexico. R. R. Lozano-Dominguez,* C. F. Arechiga, R. M. Rincon, F. J. Escobar, and J. M. Silva, *Universidad Autonoma de Zacatecas, Zacatecas, Mexico.*

The objective of this study was to evaluate annual abortion rate and consequences of abortion on dairy management, milk production and herd growth of intensive dairies in central Mexico. Abortions, as well as productive and reproductive events after abortion, were recorded for 2 consecutive years. Records included abortion-conception interval, days in milk, days to culling of cows post-abortion and days of gestation when abortion occurred. Annual rate of abortion, as well as percentage of pregnant cows and percentage of culled cows were calculated. Productive and reproductive events were analyzed using an ANOVA where parity and the reproductive state post-abortion were considered as main effects, and the herd as a block. Proportional variables were analyzed by multiple logistic regressions. Annual rate of abortion was variable between herds with a range of 13.3 to 19.9% ($P < 0.01$). Days of gestation at the time of abortion in multiparous cows with a parity greater than 3 (182.9 ± 3.6 d) was higher ($P < 0.05$) than in primiparous cows (165.7 ± 5.3 d). Stage of gestation (thirds) at the time of abortion and parity were not important on the percentage of pregnant cows after abortion ($P > 0.05$). Days in milk (274 ± 155.2 d) and abortion-conception interval (124.2 ± 96.4 d) were similar for parity ($P > 0.05$). Pregnant cows after abortion had more days in milk (307.6 ± 9.2 d) than non-pregnant cows (175.4 ± 11.7; $P < 0.01$). It was found that 36% of the cows that aborted were eliminated or culled by 223.1 ± 177.4 d post-abortion whereas only 19.5% of cows pregnant were culled ($P < 0.01$). Elevated abortion rates negatively compromised cow replacements, production and management of dairy farms located in central Mexico.

Key Words: dairy cow, abortion, Mexico

M237 Prevalence of dairy cattle diseases and abortion in central Mexico. C. Murillo, R. R. Lozano, C. F. Arechiga,* M. Rincon, and Z. Cortes, *Autonomous University of Zacatecas, Zacatecas, Mexico.*

Objective of this study was to describe prevalences, risk populations, and in some cases risk factors for diseases such as Leucosis, Paratuberculosis and Brucellosis in dairy cattle of Aguascalientes state in Central Mexico. Serum samples were collected to analyze for Leucosis (n = 340), Paratuberculosis (n = 422), and Brucellosis (n = 445) and it was found that the prevalence for those diseases was 51.6%, 16.3% and 20.3%, respectively. There was an association ($P = 0.01$) between cows having abortion 15 d before the blood sampling and Brucellosis. Abortion prevalence was also evaluated in milking herds at highlands of Central Mexico (Aguascalientes and Jalisco states). Four dairy herds that had similar management (i.e., related to preventive medicine, health and sanitary conditions, production, nutrition, and reproduction) were evaluated. Abortion cases were reported (n = 810), with 183.4 ± 58.0 d of gestation at abortion, average days in milk at abortion of 328.7 ± 130.9 d, interval from abortion to new pregnancy of 355.9 ± 197.7 d, and 73.9% of cows calving after abortion. Culling of cows as a consequence of abortion was reported as 36.0% with an average days in milk of 223.1 ± 177.4 d. It was also observed that 35.3% of cows had abortions during the dry period. This study provided some descriptive information related to disease and abortion prevalences in Central Mexico's dairy herds.

Key Words: dairy cows, brucellosis, Mexico

M238 Analysis of factors affecting heifer fertility traits in Chinese Holstein. Y. Wang*[1], X. Guo[1], G. Guo[2,4], X. Li[2], L. Liu[3], W. Zheng[3], T. Yang[3], Q. Liu[5], Y. Zhang[1], S. Zhang[1], and Y. Zhang[1], *[1]College of Animal Science and Technology, China Agriculture University, Beijing, China, [2]Beijing Sanyuan Lvhe Dairy Cattle Center, Beijing Sanyuan Breeding Technology Co., Beijing, China, [3]Beijing Dairy Cattle Center, Beijing, China, [4]Institute of Animal Science, Chinese Academy of Agricultural Sciences, Beijing, China, [5]Beijing Capital Agribusiness Group, Beijing, China.*

The improvement of fertility in heifers plays a key role in improving longevity and lifetime production in dairy farm. However, there were only few studies analyzing fertility traits in Chinese Holstein. The objective of current study was to identify factors affecting fertility traits in heifers and to provide a theoretical basis for improving dairy cattle production efficiency in Chinese Holstein. Data of fertility traits from 22 dairy farms (2000 to 2010) were collected from Beijing Sanyuan Lvhe Dairy Cattle Centre, including interval from first service to conception (FSTC) and conception rate for first insemination (CR) in heifers. The final data set included 23,035 heifers, daughters of 119 bulls. Fixed effects of herd, birth year, birth season, year of first mating, season of first mating, and sire were considered in the model, and SAS 9.1 was used to run the analysis. The simple statistics for FSTC and CR were 13.59 ± 30.82 d and 74.4% ± 43.7%, respectively. All factors studied had significant association with FSTC and CR ($P < 0.05$ or $P < 0.01$) except birth season. For FSTC and CR, the largest differences among farms were 14.28 d and 26.0%, respectively. For heifers born in year 2000, average FSTC and CR were 0.34 d and 99.7%, respectively; thereafter there was a declined trend for reproductive efficiency, e.g., average FSTC increased about 3 d per year while CR decreased 6.0% per year from birth year 2000 to birth year 2006. Birth year 2006 became a turning point, since then both FSTC and CR started to be improved. Year of first mating showed exactly the same trend as birth year did. Therefore further analysis of fertility traits can drop birth season and either of the 2-year factors. The heifers first mated in colder seasons (autumn and winter) had lower CR (2.9%) and longer FSTC (1.29 d) than those mated in warmer seasons (spring and summer). The effect of

sire was significant, which means genetic selection could improve heifer fertility performance. In conclusion, heifer reproductive performance was influenced by multiple factors, and could be improved by better on-farm management and selection of a fertile sire.

Key Words: fertility traits, heifer, Chinese Holstein

M239 Characterization of certified organic Wisconsin dairy farms: Management practices, feeding regimens, and milk production. C. A. Hardie*[1], V. E. Cabrera[1], M. Dutreuil[1], R. Gildersleeve[2], and M. Wattiaux[1], *[1]University of Wisconsin-Madison, Madison, [2]University of Wisconsin Extension, Dodgeville.*

The purpose of this project was to characterize certified organic Wisconsin dairy farms and evaluate their feeding regimens during the course of 2010. Farms were identified by cross listing 2 separate directories: the Wisconsin Active Dairy Producers and the Wisconsin Certified Organic Producers. All resulting organic dairy herds from these lists were invited to participate (n = 565) in this study. An on-site survey containing sections on farm demographics; feeding, pasturing, cropping and nutrient management practices; sources of income; and farm satisfaction was conducted on 54 farms throughout the state between March 2011 and January 2012. Forty-six percent of the farms relied entirely on family labor to complete farm chores. Total area operated ranged from 17.8 to 775.6 ha, with a mean (±SD) of 123.4 (±133.4). Hectares of pasture ranged from 6.1 to 145.8, with a mean (±SD) of 40.9 (±30.84). Herd size ranged from 12 to 650 cows, with a mean (±SD) of 71.3 (±92.2). The predominant breed varied on the farms, too, with 51.9, 27.8, 9.3, and 11.1% of the herds having Holstein, crossbred, Jersey, and other, respectively as their major breed. Milk rolling herd averages varied from 2,356 to 10,274 kg/cow per year, with a mean (±SD) of 6,182 (±1,846). Total dry matter intake (DMI) for lactating cows ranged from 11.8 to 25.6 kg/cow per day, with a mean (±SD) of 19.8 (±3.4). Peak pasture intake during the grazing season ranged from 1 to 100 percent of total DMI, with a mean (±SD) of 69.1 (±25.5). The farms' grazing seasons in 2010 ranged from 122 to 244 d, with a mean (±SD) of 182.0 (±28.7). During the grazing season, 79.6, 13.0, and 31.5% of the herds supplemented grain, protein, and corn silage, respectively. As indicated by the ranges and SD presented here, certified organic Wisconsin dairy farms varied widely in farm characteristics, feeding regimens, and animal production. Awareness of these extreme variations should help design extension programs and agricultural publications better suited to meet the educational needs of this growing dairy sector. Supported by AFRI Competitive Grant no. 2010–51300–20534.

Key Words: organic, grazing, supplementation

M240 Impact of dairy herd reproductive performance on predicted economic performance, enteric CH_4 emission and excretion of N and P using a Markov-chain model. M. J. Aguerre,* J. O. Giordano, A. S. Kalantari, M. A. Wattiaux, P. M. Fricke, and V. E. Cabrera, *University of Wisconsin-Madison, Madison.*

Our objective was to estimate the effect of reproductive performance on predicted enteric CH_4 emission, and N and P excretion of lactating and dry cows in a dairy herd. A Markov chain model was used to simulate herd dynamics based on productive and reproductive input parameters. Different herd structures were obtained after simulation of herds with 12 (Low) vs. 22% (High) 21d-pregnancy rate. Lactation curves from a commercial farm were used to simulate milk production whereas DMI was calculated based on NRC 2001 empirical equation. Diets for cows in early (0 to 150 DIM) or late (>150 DIM) lactation contained 16.7 vs. 15.4% CP, 44.2 vs. 41.4% NFC, 10.4 vs. 11.2% hemicellulose (HC), 16.7 vs. 23.0% cellulose (CEL) and 0.38 vs. 0.34% P, respectively. Dry cows diet was formulated to contain 13.2% CP, 34.8% NFC, 14.3% HC, 24.8% CEL and 0.27% P. Enteric CH_4 emission was predicted by an empirical equation (CH_4 g/d = [(0.814 + 0.122 x intake NFC kg + 0.415 x intake HC kg + 0.633 x intake CEL kg)/0.05565]. Manure N and P excretion (g/d) was predicted by difference between intake and milk secretion for each element. Net value ($/cow per yr) for High and Low pregnancy rate were calculated by summation of income over feed cost, replacement cost, reproductive program cost, and calf value. Compared with Low, High program resulted in higher milk production per lactating cow (40.3 vs. 41.8 kg/d), lower percentage of lactating cows (90.6 vs. 88.8%), lower average DIM (188 vs. 176), and higher income over feed cost (7.76 vs. 7.84 $/cow per d). In addition, High outperformed Low by $69.4/cow/yr. Predicted CH_4 and CH_4/milk were 425 g/d and 11.64 g/kg for Low and 419 g/d and 11.37 g/kg for High which represented a 1.4 and 2.3% reduction. Relative to Low, with the High program N and P excretion were reduced by 1.1% (373 vs. 369 g/d) and 1.3% (45.0 vs. 44.4 g/d), respectively. Under the simulation conditions of this study, changes in herd structure associated with improved reproductive performance reduced predicted environmental impact while improving profitability.

Key Words: reproductive performance, methane, nitrogen and phosphorus

M241 Reproductive indicators of dairy enterprises in north and west Mexico. H. Estrella-Quintero,* D. V. Mariscal-Aguayo, R. Núñez-Domínguez, and G. Maldonado-García, *Universidad Autónoma Chapingo, Chapingo, Estado de México, México.*

The purpose of this study was to evaluate the reproductive performance of family-based dairy enterprises in transition and business considering their technological level. Transition enterprises are those moving from subsistence to business, the latter being the ones that market all their products. The information used was registered in the AGROPEC Star software of 12 farms in transition level and 7 in business level located in northern and western Mexico, with a total of 3,935 Holstein cows and for a period from 1996 to 2011. The variables evaluated were: services per conception (SPC), calving interval (CI), calving to first estrus interval (CFEI) and interval from calving to first service (CFSI). A mixed model was used that included fixed effects of technological level, and number, year and season of birth, and significant 2-way interactions between these effects, and as random effects, the enterprise nested in the technological level and cow within enterprise. The technological level had an effect ($P < 0.05$) in SPC and CI; the interaction of technological level by year of birth had an effect ($P < 0.05$) in all the variables. The transition technological level had 1.8 ± 0.05 SPC and 403.4 ± 4.9 d of CI lower ($P < 0.05$) than the business technological level which averaged 2.08 ± 0.09 and 426.7 ± 8.1 d, respectively. No significant differences were found between technological levels for CFEI and CFSI. In conclusion, enterprises in transition had better reproductive performance than business enterprises.

Key Words: enterprises, cows, Holstein

M242 Seasonal variation on milk components and relation to quality payment program. L. C. Roma Junior*[1], A. C. S. Gonçalves[1], and P. F. Machado[2], *[1]APTA Centro Leste, Ribeirao Preto, Sao Paulo State, Brazil, [2]Clínica do Leite, ESALQ/USP, Piracicaba, Sao Paulo State, Brazil.*

The existence of a wide variation in milk quality in subtropical regions due to season of the year has been reported previously. However,

participation in a payment program based on milk quality can generate profits or losses to the producer due to this variation. The main objective of this study was to quantify the effect of milk price variation, recognizing significant causes of it and possible parameters that need more attention. For one year, 250 dairy farms in the Southeast region of Brazil were inspected for the following milk parameters: fat, protein, non-fat solids, somatic cell count and total bacterial count. At the same time, monthly climate data were collected in the region to observe climate variability and allow investigation correlating those data with the outcomes. The randomized design was used, with season as a factor (summer, autumn, winter and spring). The means were evaluated using Proc GLM, by Tukey test with a significance level of 5%. It was observed that there was a significant effect between variation on milk quality and final price of the marketed milk. The bonus variation ranged from 2.34% (spring) to 7.87% (autumn), and the only season that showed a significant variation in the milk price was autumn ($P < 0.05$). One of the factors that influenced the bonus the most was somatic cell count, contributing with a year average penalty of 1.89%, followed by bacterial count, with a penalty of 0.24%. On the other hand, milk protein was the component responsible for providing most of the bonus, averaging 3.77%. In conclusion, there was an effect of season on bonus/penalty for the producer; somatic cell count was the variable that penalized price the most. Knowledge on the effect of season in payment amount for quality can inform the producer, who should act to prevent and control quality of milk produced. In some cases, the producer would be able to concentrate milk production increases and calving at a season when best bonuses are offered, aiming to achieve greater production profitability. Financial support by FAPESP, process 05/51369-8.

Key Words: environmental effects, payment for milk quality, seasonability

M243 Effects of temporary calf removal (CR) prior to fixed-time AI (TAI) on pregnancy rates and subsequent calf performance in suckled beef cows. G. H. L. Marquezini,* F. M. C. Silva, K. M. Bischoff, T. E. Black, V. R. G. Mercadante, N. DiLorenzo, and G. C. Lamb, *North Florida Research and Education Center, University of Florida, Marianna.*

Two experiments were conducted to determine the effect of calf removal (CR) on pregnancy rate and calf performance in suckled beef cows. Cows were synchronized with the 7-d CO-Synch + CIDR protocol (100 µg injection of GnRH at CIDR insertion [d −7] with 25 mg injection of $PGF_{2\alpha}$ at CIDR removal [d 0], followed by injection of GnRH and TAI on d 3). Cows were stratified by d postpartum, BCS, and parity and assigned to one of 2 treatments in Exp. 1: CON (control; n = 156) and CR72 (calves were separated from their dams for 72 h from d 0 and 3; n = 168); and one of 4 treatments in Exp. 2; CON (n = 105), CR72 (n = 107), CR48A (CR for 48 h from d 0 to d 2; n = 99), and CR48B (CR from d 1 to d 3; n = 53). Follicle dynamics and CL development were assessed on d 0, 3, and 10 and pregnancy status determined on d 30. Blood was collected on d −14, −7, 0, 3, and 10 to determine P4 and E2. Overall pregnancy rates did not differ among treatments (Exp. 1, 50.3%, $P = 0.58$; Exp. 2, 49.1%, $P = 0.15$). In Exp.1, CR72 (0.42 ± 0.15 mm/d) had increased follicle growth rate ($P < 0.01$) from d 0 to 3 compared with CON (0.02 ± 0.15 mm/d), but there were no differences in follicle diameter on d 0 or 3 ($P > 0.1$). In Exp. 2, E2 concentrations were greater ($P < 0.01$) in the CR72 treatment at 24 h after $PGF_{2\alpha}$ compared with other treatments (7.4 ± 1.4, 14.6 ± 1.6, 8.4 ± 1.6, and 7.7 ± 1.6 pg/mL for CON, CR72, CR48A, and CR48B, respectively). Young (25 to 59 d of age) and old (>80 d of age) calves lost a greater ($P < 0.05$) percent of body weight (PBW) during CR than medium (60 to 79 d of age) aged calves exposed to CR72 (−4.7 ± 0.4%, −1.9 ± 0.4%, and −2.5 ± 0.5% PBW change for young, medium, and old, respectively) and to CR48 (−4.8 ± 0.5%, −2.1 ± 0.6%, and −2.6 ± 0.8% PBW change for young, medium, and old, respectively), whereas CON calves gained weight during CR (3.7 ± 0.4%, 1.7 ± 0.5%, and 2.1 ± 0.5% PBW change for young, medium, and old, respectively). We conclude that CR was not able to improve pregnancy rates but did increase follicle growth rate before TAI. Subsequent calf performance was affected by 72 or 48 h calf removal.

Key Words: calf removal, artificial insemination, beef cows

M244 Effect of cattle processing and handling on changes in measures of temperament during a 70-d feed efficiency test. K. M. Bischoff,* T. E. Black, V. R. G. Mercadante, G. H. L. Marquezini, D. Henry, N. DiLorenzo, and G. C. Lamb, *North Florida Research and Education Center, University of Florida, Marianna.*

We determined the effect of animal handling and processing over a 70-d feed efficiency test (FET) on changes in temperament in beef cattle. Over a 3-yr period (2009 to 2011) 8 separate groups of bulls (n = 526), steers (n = 182), and heifers (n = 133) comprising *Bos taurus*, *Bos indicus*, or *Bos taurus* × *Bos indicus* genetics were processed through the University of Florida Feed Efficiency Facility using a GrowSafe feed intake system (GrowSafe Systems Ltd., Alberta, Canada) for a FET. Animal was the experimental unit. Cattle were exposed to a 14 d acclimation period before initiation of a 70 d FET. Cattle were processed every 14 d (d0, d14, d28, d42, d56, and d70) for collection of BW and temperament data. Temperament data consisted of chute score (CS) and exit velocity (EV). Chute score, the subjective measurement of the behavioral response to restraint in the squeeze chute, was assigned on a 1 to 5 scale (1 = calm and docile; 2 = restless; 3 = nervous; 4 = excited and flighty; 5 = aggressive) and EV was the speed (m/s) at which each animal exited the squeeze chute and passed by infrared sensors placed 1.83 m apart. Chute score (r = −0.199) and EV (r = −0.254) were correlated with BW ($P < 0.001$) and EV was correlated with CS ($P < 0.001$; r = 0.273). For repeated measures analysis on CS and EV, BW was used as a covariate and day as the repeated variable. There was no effect of sex ($P = 0.119$) on CS. However, CS was affected by breed ($P = 0.002$) with 50% Angus-50% Brahman (50/50) crossbred cattle having greater CS than Ultra Black (UB; 75% Angus, 25% Brahman) cattle ($P = 0.04$). In addition, Brangus (BN; $P < 0.001$) and Brahman cross (BX; $P = 0.003$) cattle had greater CS than Angus (AN) cattle, with BN having greater CS than UB ($P = 0.02$). For EV, a breed × sex interaction existed ($P = 0.047$) indicating that EV for heifers of BN origin was greater ($P < 0.01$) than for bulls of BN origin. Exit velocity did not differ ($P < 0.01$) between sexes among all other breeds. There was a group × day interaction ($P < 0.001$) for CS and EV, with cattle from differing FET groups having differences in CS and EV as d on test progressed. In conclusion, handling and processing during a FET did not improve animal temperament, and changes in CS and EV during a FET appear to be associated with previous management and herd genetics, as evidenced by the group × day interaction. However, breed influenced CS and EV during a 70-d FET.

Key Words: temperament, beef cattle, animal handling

M245 Culling reasons and the association of herd size and milk yield with culling rates in dairy herds in southern Brazil. R. Almeida*[1], D. F. F. Silva[1], L. Alegransi[1], R. B. Navarro[2], A. A. Valloto[3], and J. A. Horst[3], *[1]Universidade Federal do Paraná, Curitiba, PR, Brazil, [2]Capal Cooperativa Agroindustrial, Arapoti, PR, Brazil, [3]Associação Paranaense de Criadores de Bovinos da Raça Holandesa, Curitiba, PR, Brazil.*

The objective of this study was to identify reasons for culling lactating dairy cows in herds located in Arapoti county, Paraná State, southern Brazil. In addition, the association of culling rate with milk yield and herd size was also investigated. Statistical analyses were performed using CORR and GLM procedures (SAS), and herd within year was the experimental unit. A multivariate regression model was developed, where culling rate was the dependent variable, and year, herd size, and herd milk yield categories were the independent variables. Data set included 21 herds and data were collected from January 2007 to December 2010. A total of 3,961 cows were culled or died in these herds during the study period. The most important reasons for culling were reproductive disorders (33.5%), clinical mastitis and high somatic cell count (22.2%), and feet and leg problems (18.5%). The first 3 mo of lactation were critical; 28.1% of deaths and culls were observed during this period. Approximately one-fifth (19.8%) of culled cows were first-parity females. Culling rates were lower ($P < 0.05$) in the first 2 years (21.9% in 2007 and 24.2% in 2008) than in the last 2 years (26.2% in 2009 and 26.4% in 2010) of the study. The observed culling rates were lower than the 30% culling rate typically found in confined herds in Brazil, suggesting that the current milk prices encouraged dairy farmers to keep cows in their herds longer. Small herds (less than 150 cows) had lower culling rates ($P < 0.05$) than medium (150 to 250 cows) and large herds (more than 250 cows). The correlation between culling rate and herd size was moderately positive (r = 0.25; $P < 0.05$), suggesting that small herds kept cows for more lactations. There was a difference in culling rates between high- and low- milk yield herds and the correlation between these 2 variables was significant (r = 0.26; $P < 0.05$). Larger and higher-producing dairy farms had higher culling rates in the subtropical south of Brazil and these farms should carefully investigate culling reasons in their herds to identify areas for improvement.

Key Words: culling rate, reproduction, herd size

M246 Nitrogen utilization efficiency in specialized dairy herds in southern Brazil. D. Jerszurki[1], L. Jerszurki[2], R. B. Navarro[3], A. Ostrensky[4], G. T. Santos[5], and R. Almeida*[1], *[1]Universidade Federal do Paraná, Curitiba, PR, Brazil, [2]Universidade Tecnológica Federal do Paraná, Curitiba, PR, Brazil, [3]Capal Cooperativa Agroindustrial, Arapoti, PR, Brazil, [4]Pontifícia Universidade Católica do Paraná, Curitiba, PR, Brazil, [5]Universidade Estadual de Maringá, Maringá, PR, Brazil.*

The objective of this study was to determine current nitrogen utilization efficiency (NUE) of dairy herds in Arapoti county, Paraná State, southern Brazil, as well as to evaluate possible effects of dietary crude protein (CP) levels and milk yield on NUE. Twenty-eight commercial herds mostly containing Holstein cows and producing 29.0 ± 3.9 kg/cow/d were studied in a 5-year period (from January 2007 to December 2011). Each herd was monitored on average 4x per year, totaling 547 visits in the evaluation period. For validation purposes, on-site collection of TMR, milk, feces, and urine samples was conducted in 6 participating herds on February 2011. Freshly deposited feces were sampled just after being excreted by 60 lactating cows, randomly selected within herd. Urine samples from another 60 cows also randomly chosen were collected by a noninvasive method and mixed to make a composite urine sample with H_2SO_4 solution. Daily fecal and urinary volume excretions were estimated by the equations from the American Society of Agricultural and Biological Engineers Standards (ASAE, 2005). Statistical analyses were carried out with GLM procedure of SAS, and each farm visit was considered as an experimental unit. A multivariate regression was developed with NUE as the dependent variable, herd, year, and season as fixed effects, and milk yield as covariate. Estimated variables with their respective means and standard deviations were: 523 ± 49 g/d N intake (15.6 ± 0.7 dietary CP), 143 ± 19 g/d milk N (3.14 ± 0.11 milk protein %), 202 ± 16 g/d fecal N, 194 ± 20 g/d urinary N, and 27.31 ± 2.82% of NUE. N efficiency increased ($P < 0.01$) over the years: 25.2% in 2007, 27.0% in 2008, 27.3% in 2009, 28.0% in 2010, and 28.4% in 2011. Season was a significant effect ($P < 0.01$) only when the model did not include the covariate milk production, indicating that dairy cows had higher N balance in the winter season only because they produce more milk during cooler months. Correlations between NUE and milk yield (r = 0.64; $P < 0.01$) and between NUE and dietary CP (r = −0.27; $P < 0.01$) indicated that high-producing dairy herds that adopt conservative dietary CP levels had higher N efficiency.

Key Words: dietary protein, dairy cows