W222 Evaluation of management, nutrient consistency and sanitation of automated calf feeders. K. L. Machado,* R. E. James, and M. L. McGilliard, *Deptartment of Dairy Science, Virginia Tech, Blacksburg.*

The objective of this study was to evaluate management, sanitation and consistency of liquid diets delivered to calves via autofeeders. Ten herds in Virginia and North Carolina with sophisticated (Förster-Technik, Germany) and basic (Biotic Industries, TN) machines were asked a 60-question survey concerning calf and autofeeder management. Duplicate milk replacer samples were obtained to measure standard plate count (SPC), Brix refractometer value and temperature of liquid diet delivered by the autofeeder at the time of the survey. Dairies were also categorized based upon management strategies for the autofeeders. Producers purchased autofeeders to manipulate feeding rate, refocus labor to improved sanitation, explore new feeding options and provide better care and well-being of calves. Six dairies were visited monthly for 3 mo for continued evaluation of milk replacer from the autofeeder. Survey questions did not reveal differences related to management strategy or autofeeder type as determined by Proc Freq. Variables, SPC, Brix and temperature were analyzed by Proc Glimmix with a fixed effect of management strategy, or autofeeder type, and random effect of dairy nested in management strategy or autofeeder type, and residual. Seven herds utilizing basic machines had milk replacer liquid with a mean SPC of $6.9 \times 10^6 \pm 7.3 \times 10^6$ cfu/mL. The mean Brix and temperature readings were 12.0 ± 2.1 Brix and 38.8 ± 6.7°C. Three dairies that used sophisticated autofeeders had milk replacer liquid with a mean SPC of $1.3 \times 10^6 \pm 2.2 \times 10^6$ cfu/mL. Mean Brix and temperature readings were 10.3 ± 1.7 Brix and 38.6 ± 6.7°C. Differences could not be attributed to either management strategy or autofeeder type. This study suggests that implementation of management protocols was more important than autofeeder type or management strategy category.

Key Words: calf, automated feeder, milk replacer

W223 Performance, health, behavior and respiratory antibody production of individually vs. grouped housed dairy calves. M. S. Calvo[1], C. J. Neumeier*[1], L. E. Hulbert[1], A. Louie[2], L. J. Gershwin[3], K. E. Pinkerton[4], C. B. Tucker[1], K. C. Klasing[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.*

Individual calf housing systems are widely used in the US to inhibit competition for food and reduce the transmission of disease between calves. Future legislation could mandate group housing for dairy calves without identifying suitable alternatives. Therefore, the objectives were to evaluate the effects of individual housing versus group housing in modified hutches on calf performance, resting behavior, health and respiratory antibody production. The 2 housing treatments were: 1) individual housing (INV; 1.23 m^2/head; n = 18) and 2) group housing (GRP; 3 calves per hutch; 1.23 m^2/head; n = 16). Milk and starter intake were recorded daily and BW measured on d 0, 20, 45, 73, and 87. Visual health assessment scores were recorded daily and behavior loggers utilized on d 21–23, 47–49, and 74–76. In a sub-experiment, healthy calves from each treatment (n = 6, SML; n = 7, GRP) were sensitized (subQ) and challenged (aerosolized) with Ovalbumin (OVA) at age 76 ± 0.5 d. Bronchoalveolar lavage fluid (BALF) was collected at age 80 ± 0.5 d and was analyzed for OVA-specific IgG, IgG1, IgA, and IgE. All calves had increased ADG at 45 d of age compared with 20 d (INV: 0.53 ± 0.05 kg/d; GRP: 0.61 ± 0.04 kg/d). In addition, at age 73 d, INV calves tended ($P = 0.09$) to be more efficient than GRP calves (INV: 7.97 ± 0.45 Mcal/BW gained; GRP: 8.64 ± 0.35 Mcal/BW gained). The INV calves spent more time in the resting-position than GRP calves ($P < 0.01$). The GRP calves had greater percent days of nasal discharge than INV calves ($P < 0.05$). A greater percentage of days of clean hide scores were observed in INV than GRP calves ($P < 0.05$). However, GRP calves had less BALF OVA-IgE compared with INV ($P = 0.03$). Although GRP calves appeared dirtier and had more days with nasal discharge, the decreased BALF OVA-IgE suggests that early life microbial exposure may be beneficial to the respiratory antibody milieu later on in life, which warrants more investigation.

Key Words: bovine, performance, behavior

W224 Performance and welfare of high-yielding dairy cows subjected to 5 or 8 cooling sessions daily in a hot and humid climate. U. Moallem,* J. Miron, H. Lehrer, M. Zachut, and H. Honig, *Volcani Center, Bet Dagan, Israel.*

The objectives were to determine the effects of cooling frequency of high-yielding dairy cows on intake, milk yield, rumination time, and welfare parameters. Forty-two multiparous dairy cows were divided into 2 treatment groups and were housed in an open barn divided into 2 pens. The groups were subjected to different cooling schedules, in a crossover design as follows: cows were exposed to 5 or 8 cooling sessions per day (5CS and 8CS, respectively), in the holding area of the milking parlor. Each period lasted 4 wk, and then treatments were switched for another 4-wk period. Each cooling session lasted 45 min, comprising cycles of 30 s of showering and 4.5 min of ventilation. Rectal temperature (RT) and respiration rate (RR) were recorded twice per week at 0630 and 1600. Rumination and lying times were recorded automatically. RT was 0.16 and 1.08°C lower in 8CS than in 5CS cows in the morning and afternoon, respectively ($P < 0.001$). RR was lower in 8CS than in 5CS cows in the morning (49.1 and 54.6 breaths/min, respectively; $P < 0.001$), and more so in the afternoon (50.0 and 83.0 breaths/min, respectively; $P < 0.001$). DMI and milk yields were 9.3 and 9.6% higher in the 8CS than in the 5CS cows (27.0 vs. 24.7 and 40.1 vs. 36.6 kg/d, respectively; $P < 0.001$), with no differences in milk fat and protein contents. Daily rumination time was 7.4% longer in the 8CS than in the 5CS (440.1 and 409.6 min/d, respectively; $P < 0.001$). Although the 8CS cows moved 3 times more to the milking area for extra cooling sessions than the 5CS ones, they spent 9.9 min/d more than the 5CS ones in lying down (484.4 and 474.5 min/d, respectively; $P < 0.004$), and used more of their free time in resting than the 5CS cows: 52.0 and 43.9%, respectively ($P < 0.001$). In conclusion, increasing the cooling frequency of cows under hot and humid conditions from 5 to 8 times a day increased their intake and milk yield, and lowered their RR and RT. Moreover, the 8CS cows spent more time resting and ruminating than 5CS cows, an indication that increasing cooling frequency improved animal welfare.

Key Words: cooling frequency, animal welfare

W225 Effects of presynchronization with GnRH or prostaglandin F2α before the start of a resynchronization protocol on reproductive performance of dairy cows. A. A. Scanavez[1], L. G. D. Mendonça[1], J. G. N. Moraes[1], P. R. B. Silva[1], G. Lopes Jr.[2], and R. C. Chebel*[1], *[1]Department of Veterinary Population Medicine, University of Minnesota, Saint Paul, [2]Accelerated Genetics, Baraboo, WI.*

Objectives were to evaluate estrus expression, ovarian responses, and pregnancy outcomes of dairy cows submitted to different presynchronization protocols before the start of a resynchronization protocol. Cows from 2 herds (MN = 611 and WI = 307) were enrolled in the study 28 to 37 d after AI (d0). The GGPG treatment consisted of GnRH on d0 and start of the resynchronization protocol on d7. The PGPG treatment consisted of a prostaglandin (PG) F2α on d2 to 4 and start of the resynchronization protocol on d14. The resynchronization protocols were the Ovsynch56 and the Cosynch48 in the MN and WI herds, respectively. Cows submitted to the resynchronization protocol were randomly selected to receive or not a CIDR insert. Sub-sample of cows from the MN herd had ovaries scanned by ultrasound on the day of non-pregnancy diagnosis (n = 342) and on the days of the GnRH and PGF2α injections of the resynchronization protocol (n = 215). Diagnosis of pregnancy was done by ultrasound (MN herd) or by concentration of pregnancy-specific protein B (WI herd) at 33 ± 4 d after AI. Continuous data were analyzed by ANOVA, dichotomous data were analyzed by logistic regression, and time dependent dichotomous data were analyzed by Cox proportional hazard ratio. Mean and median intervals to re-insemination were ($P < 0.01$) greater for GGPG cows (14.8 ± 0.3 and 16 d) than PGPG cows (12.9 ± 0.3 and 8 d) as the former were ($P < 0.01$) less likely to be re-inseminated in estrus (16.2 vs. 61.4%). Percentage of cows with a CL on d0 was similar ($P = 0.24$) among treatments, but fewer ($P < 0.01$) PGPG cows had a CL at the start of the resynchronization (67.2 vs. 93.6%). Percentage of cows ovulating to the first GnRH ($P = 0.32$) and percentage of cows with a CL on the day of the PGF2α ($P = 0.19$) of the resynchronization were not different between treatments. Treatment ($P = 0.67$) and farm ($P = 0.38$) did not affect pregnancy outcome, but treatment by farm interaction tended ($P = 0.06$) to affect pregnancy outcome (MN–GGPG = 43.8 vs. PGPG = 36.2%; WI–GGPG = 39.9 vs. PGPG = 45.3%). Among cows re-inseminated at timed AI, pregnancy outcome did not differ between cows treated or not treated with a CIDR insert ($P = 1.0$). Presynchronization with PGF2α increased the number of cows re-inseminated in estrus and reduced AI interval, but pregnancy outcomes were dependent on farm.

Key Words: presynchronized-resynchronization, dairy cow

W226 Seasonal effect of a reduced dose of prostaglandin $F_{2\alpha}$ on estrus response in lactating dairy cows. R. W. Silcox,* J. B. Brinkerhoff, S. Hatch, and L. T. Jacobs, *Brigham Young University, Provo, UT.*

We have previously shown that 15 mg of prostaglandin $F_{2\alpha}$ (PGF; Prostamate) injected in the ischiorectal fossa (IRF) is just as effective in inducing luteolysis in lactating dairy cows as the normally prescribed dose of 25 mg administered intramuscularly (IM). The objective of this study was to compare estrus response in lactating dairy cows treated with 15 mg PGF IRF versus 25 mg PGF IM during different seasons of the year under field conditions experienced in a single dairy herd located in Utah. The study began in February and concluded in February the following year. The study was divided into 3 seasons: Season 1-February–April; Season 2-May–August; Season 3-September–February. Five hundred seventy-seven lactating Holstein cows (lactation number 1–5) eligible for first breeding (days in milk ≥59) were selected for study based on the presence of a responsive corpus luteum as estimated by palpation performed by a field veterinarian. Selected cows were grouped each week of the study by lactation (lactation 1 versus lactation 2 versus lactation ≥ 3) and randomly assigned within group to treatment. Estrus was detected by pedometer. Overall, cows treated with 15 mg PGF IRF had an estrus response rate (161/285; 56%) lower than cows treated with 25 mg IM (200/292; 68%; $P < 0.01$). Response rate between treatments differed during Season 2 (IRF = 46/109;42% vs IM = 70/109;64%; $P < 0.01$) but did not differ ($P > 0.05$) during Season 1 (IRF = 68/107;64% vs IM = 77/111;69%) or Season 3 (IRF = 47/69;68% vs IM = 53/72;74%). Response within treatment was unaffected by season in cows given 25 mg PGF IM ($P > 0.05$) but did differ by season in cows given 15 mg IRF ($P < 0.01$). In summary, season did not affect estrus response when cows were administered 25 mg PGF IM. In contrast, lowering the dose to 15 mg injected by way of the IRF during the summer months did reduce estrus response as compared with administration during other seasons of the year and as compared with the response in cows receiving the full dose. We conclude that lactating dairy cows should not be administered a reduced dose of PGF by way of the IRF during the summer months.

Key Words: season, prostaglandin $F_{2\alpha}$, estrus

W227 Degree of agreement between the ration formulated and the ration fed on seven California dairies. N. Silva-del-Río*[1] and A. R. Castillo[2], *[1]Veterinary Teaching and Research Center, Tulare, CA, [2]University of California, Cooperative Extension, Merced.*

Dairy nutritionists utilize computer models to formulate least cost rations that maximize feed to milk conversion efficiency. However, the nutrient composition of the fed ration often differs from the formulated ration as a result of errors associated with weighing ingredients into the mixer wagon, and uncertainties in dry matter content and nutrient composition of the ingredients. If large deviations exist between the formulated and the fed ration, important consequences on the environment and animal performance should be expected. The objective of this study was to evaluate the degree of agreement between the dairy cow ration formulated by the nutritionist and the ration fed at the feedbunk. A total of 7 dairies in Merced County, CA were enrolled in this study. Feedbunk samples of the total mixed ration were taken on 2 non-consecutive days from 4 (n = 1), 3 (n = 5) and 2 (n = 1) lactating groups, composited and assayed for CP, NDF, fat, Ca and P. Results are presented in Table 1. Dairies over or under fed more than 10% of CP (n = 4), NDF (n = 3), fat (n = 3), Ca (n = 6) and P (n = 2). Results from this study indicate that despite formulating rations to meet animal requirements, and implementing grouping strategies, we will not improve nutrient efficiency utilization unless best feeding management practices are implemented to minimize errors during the feeding process.

Table 1. Maximum and minimum percentage of nutrient under or over fed per dairy across the different total mixed rations (TMR)

Dairy	1	2	3	4	5	6	7
Milk (kg)	39	29	36	27	36	31	35
TMR #	3	2	3	3	3	3	4
CP max	21.3	14.9	14.4	−10.6	9.6	−6.1	−6.0
CP min	15.0	7.7	4.3	−4.6	1.7	−1.5	−5.3
NDF max	42.0	5.4	6.5	11.2	−5.0	17.1	18.1
NDF min	27.0	3.2	1.3	2.9	−2.2	0.1	9.6
Fat max	25.7	−5.9	15.4	−9.3	−8.5	−17.3	−13.8
Fat min	−1.3	3.8	5.5	−3.3	−4.1	−10.3	10.3
Ca max	−10.8	−7.9	−17.8	−28.6	−13.1	−17.2	−13.8
Ca min	6.7	0.3	−11.4	−22.1	−4.2	−3.6	−7.9
P max	14.7	9.7	7.2	−6.4	−5.0	14.7	6.4
P min	−4.9	−1.1	−1.0	−4.6	2.6	3.8	−2.4

Key Words: feeding management, TMR, dairy

W228 Nitrogen and phosphorus utilization by dairy cows on small and medium-sized farms. Z. Dou, J. D. Ferguson, D. T. Galligan, C. F. Ramberg, D. W. Remsburg, L. D. Baker, R. J. Munson, and Z. Wu,* *University of Pennsylvania, Kennett Square.*

Small and medium-sized dairy farms (<700 cows) are exempted from EPA nutrient management regulations, but can account for a major proportion of animals in traditional agriculture regions. Reducing nutrient loading to sensitive water bodies is a challenge that needs to be shared by animal operations of all scales. Ten dairy farms with 50 to 250 cows (900 total) were randomly selected from the Chesapeake Bay watershed in Pennsylvania and monitored for nutrient utilization for 2 yr in comparison with baseline data collected during the first 3 mo of the project. Farms were evaluated regularly for nutrition and management practices and presented with recommendations for improvement, as appropriate. Diets and feces were sampled quarterly (fecal from 5 randomly selected cows per herd) and analyzed for nutrient content. DHIA reports were collected monthly. Most of the farms used dietary P appropriately, and half of the farms reduced dietary protein during monitoring, averaging 0.38% in P and 16.5% in CP, both consistent with current industry usages and NRC standards. However, variation existed in the diets as well as fecal analysis among farms and over time within farms. Analyzed dietary P exceeded formulated concentrations, whereas the trend was the opposite for protein. Pregnancy rate (21-d) increased during the monitoring period. While combined data across farms showed that there was little change in milk production or MUN during the monitoring period, half of the farms showed improvements. Although not mandated to implement nutrient management plans, producers of small and medium farms were conscientious about dietary CP and P content, and willing to adopt new technologies to reduce excretion. Extension services for reducing nutrient excretion on small and medium farms may use the approach of identifying vulnerable farms followed by close monitoring and evaluation. Partially supported by National Fish and Wildlife Foundation.

Table 1. Protein and phosphorus utilization on small and medium dairy farms during 2-yr monitoring

Item	Baseline	Monitoring	SEM	*P*
Dietary CP, %				
Formulated	17.0	16.8	0.1	0.24
Analyzed	16.3	16.1	0.2	0.44
Dietary P, %				
Formulated	0.37	0.36	0.01	0.13
Analyzed	0.39	0.40	0.01	0.45
Fecal CP, %	17.4	17.4	0.3	0.84
Fecal P, %	0.68	0.69	0.02	0.81
Milk, kg/d	33.4	33.7	0.3	0.41
MUN, mg/dL	12.5	12.4	0.3	0.79
Pregnancy rate, %	20.4	22.7	0.5	0.01

Key Words: dairy cows, nutrient management, environment

W229 Basic economic indexes on small and medium sized dairy farms. D. T. Galligan,* Z. Dou, J. D. Ferguson, C. F. Ramberg, D. W. Remsburg, L. D. Baker, R. J. Munson, and Z. Wu, *University of Pennsylvania, Kennett Square.*

Ten dairy farms with 50 to 250 cows (averaging 87.7 cows/herd) were randomly selected from the Chesapeake Bay watershed in Pennsylvania and monitored for nutrient utilization and production efficiency for 2 yr in comparison with baseline data collected for the first 3 mo of project. Farms were evaluated regularly for nutrition and management practices and economic parameters were collected from herd accountants, tax reporting forms, and herd record systems. DHIA reports were collected monthly tracking production, herd demographics, culling, and reproductive performance. Farm wealth was hypothesized to be improved by selling products (milk, calves, and culls) as well as the accumulation of valued livestock over the course of the study. Nutrient efficiency was hypothesized to improve due to improved animal performance per unit of animal maintenance and replacement. Herds varied greatly in their nutritional, animal, and management practices and were offered evaluations and recommendations by participating study members. Herd parameters in yr 1 and 2 were compared with baseline values recorded in yr 1 as well as values reported for similar Pennsylvania herds at large. Basic economic metrics (milk price: $0.352/kg milk; marginal feed cost: $0.08/kg milk; cull values: $600; cow value: $1600) were set to average values observed over the study period so that changes in production efficiency could be observed. Milk production, estimated from changes in rolling herd average, improved by approximately 270 kg/cow over the 2-yr period with an estimated marginal value of $71.35/cow. Herd value on 8 herds (cows and heifers valued at constant prices) increased by 3% in yr 1 and 5% in yr 2 compared with starting values. Estimated net income over feed cost increased by $72.83/cow over the 2-yr period while a comparable estimate of herds with <100 cows in Pennsylvania increased by only $4.39 over the same period. Seven of the 10 farms had increases in pregnancy rate from 20.4 to 22.7% with an estimated reproduction efficiency value of $53.02 per cow per year (REPMON economic analysis). Improved nutrition by nutrient management strategies is synergistic with positive economic consequences on dairy herds. Partially supported by National Fish and Wildlife Foundation.

Key Words: dairy farm management, farm economic, dairy herd evaluation

W230 Technological level of Holstein cattle herds in the West and North of Mexico. D. V. Mariscal-Aguayo,* H. Estrella-Quintero, R. Núñez-Domínguez, and G. Maldonado-García, *Universidad Autónoma Chapingo, Chapingo, Estado de México, México.*

The objective of this study was to classify family-based dairy enterprises considering their technological level (TL). Surveys following FAO´s guidelines were applied to 45 producers, located in the states of Chihuahua, Coahuila, Durango, Aguascalientes, Jalisco and Michoacán in México, to diagnose the type and use of technology. From outputs of the surveys, indexes for reproductive (RMI), health (HMI) and nutritional (NMI) management, genetic quality (GQI), and infrastructure and equipment (IEI) were calculated. Later, these indexes were combined to get the TL by weighing each index with their importance to differentiate the enterprises. FAO´s guidelines were modified getting the weights, proportional to the variation coefficients of the indexes (26.0, 19.6, 25.0, 3.6, and 25.8% for RMI, HMI, NMI, GQI and IEI, respectively). The enterprises were classified as subsistence, transition or business (transition enterprises are those moving from subsistence to business, the latter being the ones that market all their products), if the TL was ≤0.4, > and ≤0.8 or >0.8, respectively. Eighty 6 percent of enterprises were classified in transition and 14% in business. Transition enterprises averaged 7 years of school attendance, agricultural or grazing area of 26.9 ha, herd size of 98 animals, 53 cows in milk, 20.2 L of milk/cow per day, and a milk price of $4.43/L, artificial insemination (AI) is used, 17% use bulls for mating repeated not pregnant cows, and cattle feeding is variable. Business enterprises averaged a 9 years of school attendance, agricultural or grazing area of 56.6 ha, herd size of 384 animals, 215 cows in milk, 26 L of milk/cow per day, and a milk price of $4.68/L, AI is used, cattle are confined and the feeding is based on

forage and concentrates. The TL is important to advise producers in a different manner, according to the strengths and weaknesses, to improve production efficiency of their enterprises.

Key Words: cattle, dairy enterprises, producer stratification

W231 Association of stocking density, production, and behavioral patterns of dairy cows milked in automatic milking systems. J. A. Deming[1], R. Bergeron[2], K. E. Leslie[3], and T. J. DeVries*[1], *[1]Dept. of Animal and Poultry Science, University of Guelph, Kemptville Campus, Kemptville, ON, Canada, [2]Dept. of Animal and Poultry Science, University of Guelph, Campus d'Alfred, Alfred, ON, Canada, [3]Dept. of Population Medicine, University of Guelph, Guelph, ON, Canada.*

The objective of this cross-sectional study was to examine the associations between stocking density, production, and behavioral patterns of cows milked in automatic milking systems (AMS) under commercial management settings. Thirteen AMS farms were enrolled in the study. Average herd size was 71 ± 30 lactating cows. Farms either had 1 (n = 11) or 2 (n = 2) AMS units. All of the farms utilized free-stall barns, each set up for free cow traffic. Across farms there were, on average, 55 ± 10 cows/AMS, 0.9 ± 0.1 cows/free stall, and 0.66 ± 0.17 m/cow of feed bunk space. A random sample of 30 cows per herd was selected to monitor standing and lying behavior for 4 d using electronic data loggers. Times of feed delivery and feed push-up were recorded daily. Milking times and yield were automatically recorded by the AMS units. Data were analyzed in multivariable mixed-effect regression models. Cows were milked less frequently ($P < 0.05$) when they were further in lactation, were of higher parity, and as AMS stocking density (#cows/AMS) increased; milking frequency (#/d) = −0.003(SE = 0.0004) × DIM + −0.06(SE = 0.03) × parity + −0.02(SE = 0.009) × cows/AMS + 4.4(SE = 0.5). Milk yield increased with feed bunk space and parity ($P < 0.05$) and decreased ($P < 0.001$) with DIM; milk yield = 16.9(SE = 5.3) × bunk space (m/cow) + 1.9(SE = 0.03) × parity + −0.05(SE = 0.004) × DIM + 26.6(SE = 3.7). Lying bout lengths increased with DIM ($P = 0.02$) and tended ($P = 0.11$) to increase with more feed bunk space; bout length (min/bout) = 0.035(SE = 0.01) × DIM + 36.7(SE = 21.7) × bunk space (m/cow) + 49.0(SE = 14.8). Cows spent more time lying down ($P = 0.02$) the further along they were in lactation; lying time (h/d) = 0.004(SE = 0.001) × DIM + 7.5(SE = 0.7). Cows of higher parity stood longer after milking ($P = 0.003$); post-milking standing time (min) = 5.3(SE = 1.8) × parity + 63.2(SE = 6.7). The results suggest that within AMS herds, more milkings per cow may be achieved with having fewer cows per AMS unit. Further, in AMS herds, longer lying bouts and greater milk yield may be achieved with providing more feed bunk space per cow.

Key Words: automatic milking, behavioral pattern, stocking density

W232 Performance of dairy cows managed with automatic milking and three contrasting feeding systems. S. A. Utsumi* and D. K. Beede, *Michigan State University, East Lansing.*

The effects of contrasting feeding systems (FS) on milk production and frequency of milkings in 2 separate herds of Holstein cows (n = 45 to 53 cows/herd) managed with automatic milking systems (AMS) was quantified in this pilot study. Feeding systems were: pasture grazing (GRASS); total mixed ration (TMR); and, pasture grazing plus supplemental TMR (pTMR) lasting 66, 51 and 96 d, respectively. Average DIM and parity of cows for the 3 FS were 169 ± 13(mean ± SE) and 2.3 ± 0.2, respectively. Cows received in addition to basal diets in the FS, 1 kg of concentrate per 4 kg of milk. Voluntary milking with one single-stall AMS per herd was applied at variable rates of 4 to 2 milkings/day based on DIM and daily milk yield. ANOVA for a completely randomized design (Proc Mixed, SAS) and path analysis (Proc Calis, SAS) of standardized regression coefficients (r) for the interrelationships among milk yield, milking frequency and concentrate intake was conducted using a total of 14,035 daily cow records. As expected, milk yield, milking frequency and body weight were greater ($P < 0.001$) for cows in TMR, intermediate for those in pTMR and lower for those in GRASS (Table 1). Conversely, cow activity in GRASS increased ($P < 0.001$) by 46% and 68% compared with pTMR and TMR, respectively (Table 1). Path analysis detected greater direct effects ($P < 0.05$) of concentrate intake on milk yield for GRASS (r = 0.52) compared with pTMR (r = 0.46) and TMR (r = 0.44) feeding systems. Conversely, the path analysis detected lower direct effects ($P < 0.10$) of milking frequency on milk yield for GRASS (r = 0.14) compared with the pTMR (r = 0.21) and TMR (r = 0.32) feeding systems. This analysis highlights the importance of proper concentrate feeding in FS, increasingly limited by low feed or energy intake, such as in GRASS, and the potential milk yield response to increased milking frequency in FS offering increasing amounts of feed or energy intake, such as pTMR and TMR.

Table 1. Cow performance in three feeding systems

Response	GRASS	pTMR	TMR
Milk yield, kg/d	23.0[c]	27.0[b]	30.1[a]
Milking frequency, /d	2.4[c]	2.7[b]	3.1[a]
Body weight, kg	566[b]	574[ab]	597[a]
Activity, accelerometer counts	415[a]	284[b]	245[c]

[a–c]Means within a row with different superscripts differ ($P < 0.05$).

Key Words: automatic milking systems, feeding systems, pasture-based dairy

W233 Potential for a real-time location system for dynamic tracking of dairy cow location within dairy facilities. R. A. Black*[1], T. S. Stombaugh[1], S. R. Luciani[2], M. P. Sama[1], R. L. Klingenfus[3], A. B. Klingenfus[3], and J. M. Bewley[1], *[1]University of Kentucky, Lexington, [2]AiRISTA, Sparks, MD, [3]Harvest Home Dairy, Crestwood, KY.*

The objective of this study was to evaluate the potential accuracy of real time location systems (RTLS), commonly used to track assets or people, within a roofed dairy facility. AiRISTA (Sparks, MD) developed a leg-based RTLS tag incorporating Wi-Fi and RFID to locate tags through received signal strength indication (RSSI). The RTLS was installed in a newly constructed 120-cow compost bedded pack barn, measuring 59.1 long (X plane) by 39.6m wide (Y plane). Six locators, mounted around the perimeter of the barn to transmit a signal, and 6 access points, mounted throughout the barn interior to send and receive signals, were installed at 4.3m high. X and Y coordinates of 43 evenly distributed locations throughout the barn were obtained with a total surveying station (Trimble SPS390 Universal Total Station, Sunnyvale, CA). Calibration was achieved using AirCalibrator software and tags and 7 reference location (RL) poles. The total surveying station determined RL coordinates. To assess system accuracy, a tag was attached to the researcher's leg while the researcher rotated among each RL 5 times to obtain X and Y coordinates for 35 samples. The mean (±SD) difference from the RL for the X coordinate was −0.08 ± 0.85m, ranging from −1.49 to 1.12m, and 0.37 ± 0.55m for the Y-coordinate, ranging from −0.46 to 1.36m. The mean (±SD) root squared error of the mean (RSEM) was 0.91 ± 0.48m. The mean (±SD) of the X and Y coordinates and RSEM for each location are depicted in the table below. A RTLS system may be

able to identify animal position within a few meters, although additional validation with multiple cows is needed.

Table 1. Mean (±SD) of X and Y coordinates (m) and RSEM (m) for each RL

Location	X-coordinate	Y-coordinate	RSEM
1	50.02 ± 2.12	9.49 ± 1.91	1.22
2	43.05 ± 0.87	8.56 ± 1.64	0.87
3	34.30 ± 1.53	9.01 ± 1.49	0.39
4	26.67 ± 0.68	8.80 ± 1.46	0.49
5	19.34 ± 1.50	7.78 ± 1.67	1.36
6	14.86 ± 1.68	8.70 ± 1.03	1.56
7	6.33 ± 1.53	8.85 ± 0.95	0.46

Key Words: real time location system, animal tracking, dairy

W234 Effects of prepartum dietary energy density and postpartum extruded full-fat soybean (ESB) supplementation on energy balance and productive performance of transition dairy cows. H. Su,* F. Wang, Z. Yang, Z. Cao, and S. Li, *State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University, Beijing, China.*

The objective of this study was to determine the ideal energy density that could alleviate negative energy balance (NEB) without jeopardizing milk production of transition cows. Three prepartum diets of different energy levels (NEL = 5.25, 5.88 and 6.48 MJ/kg DM for L, M and H, respectively) and 2 postpartum diets (basal TMR or supplementing with 1.5 kg/d ESB in the first 30 d of lactation) were studied in a 3 × 2 factorial design experiment. Sixty multiparous dairy cows were blocked according to expected calving date, BW, BCS, parity and previous mature-equivalent milk into 6 groups, and each group was randomly allocated to one treatment. Individual feeding started 3 wk before the expected calving date and measurements were taken until 56 DIM. All data were analyzed using the PROC MIXED procedure of SAS (version 9.1). With the increase of prepartum dietary energy density, the birth weight of calves increased ($P < 0.05$), and prepartum DMI as well as energy balance of the transition cows improved ($P < 0.01$). However, compared with L and M groups, postpartum DMI of H group tended to decrease ($P < 0.079$), and postpartum BCS decreased significantly ($P = 0.007$). From 35 to 56 DIM, milk yield tended to decrease ($P = 0.061$) and milk fat and protein yields were lower ($P < 0.05$) for cows in the H group. Milk urea nitrogen (MUN) concentration ($P = 0.034$) and postpartum plasma nonesterified fatty acids (NEFA) concentration ($P < 0.10$) of M group were the lowest. By supplementing ESB during early lactation, the dairy cows had greatly improved energy balance ($P < 0.05$), less BW loss ($P = 0.09$), and a tendency for increased milk yield ($P < 0.10$). Taking all these results into account, feeding prepartum diets of low or medium energy and supplementing 1.5 kg/d ESB in the postpartum diet might be the best approach for alleviating NEB, improving productive performance and maintaining optimum health in transition dairy cows.

Key Words: transition cow, energy balance, productive performance

W235 Physiological and productive responses to seasonal variation in transition dairy cows. H. Su,* F. Wang, Z. Yang, Z. Cao, and S. Li, *State Key Laboratory of Animal Nutrition, College of Animal Science and Technology, China Agricultural University, Beijing, China.*

The objective of this study was to investigate physiological and productive responses of cows calving in summer compared with cows calving in autumn. During each season, 20 multiparous Holstein dairy cows were selected and dried off 60 d before expected parturition, and balanced according to BW (699 ± 34 kg), BCS (3.57 ± 0.17), parity (2.14 ± 1.22) and previous mature-equivalent milk (7520 ± 858 kg). The cows were monitored from the last 3 wk of pregnancy until 21 DIM. All cows were fed a TMR formulated to meet or exceed NRC (2001) requirements. The average temperature-humidity index (THI) was 75.9 ± 3.1 in summer and 52.9 ± 7.1 in autumn. Results showed that cows were experiencing heat stress for nearly 96% of the test days during summer. In comparison with the autumn group, cows in summer had significantly increased rectal temperature and respiration rates ($P < 0.01$), decreased BW, BCS and DMI ($P < 0.05$), which induced more severe negative energy balance (NEB) ($P < 0.01$). Cows that experienced transition period during summer also had lower milk yield, percentages of milk fat, protein, solids-not-fat (SNF), and feed efficiency ($P < 0.01$), but higher concentration of milk urea nitrogen (MUN) ($P < 0.01$) and a tendency for higher somatic cell count (SCC) ($P = 0.054$). In addition, plasma concentrations of insulin, leptin, glucose, triiodothyronine (T3), thyroxine (T4) and cortisol of cows calving in summer were significantly lower ($P < 0.05$), whereas the concentrations of plasma glucagon, urea nitrogen, nonesterified fatty acids (NEFA) and β-hydroxybutyrate (BHBA) were significantly higher within 14 d postpartum ($P < 0.05$). In conclusion, compared with cows calving in autumn, cows calving in summer not only had more severe NEB and lower milk production, but also were at higher risk for health disorders. Based on our findings, we suggest producers avoid breeding dairy cows for calving during the hot season.

Key Words: transition cow, physiology, seasonal variation