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858 Infrared thermography for detection of hoof lesions in dairy cattle. A. Orman[1] and M. I. Endres*[2], [1]*University of Uludag*, *Bursa, Turkey*, [2]*University of Minnesota*, *St. Paul*

Lameness is one of the most important health, economic, and welfare problems in dairy farms today. The objective of this study was to investigate the use of infrared thermography (IRT) for detection of different types of hoof lesions. Early detection of lesions could result in a reduction of severe cases of lameness. A total of 139 lactating dairy cows housed either in a tie-stall or a free stall barn were used. Thermal images of the rear feet were taken with a HSI3000AS (Palmer Wahl) camera and evaluated using Wahl HSI 3000 Imager software. Hoof lesions identified in the study included white line disease (WLD), sole ulcer (SU) and digital dermatitis (DD). Hoof temperatures at the coronary band (CB) and the skin (S) were recorded. Cows were scored for locomotion on a scale of 1 to 5, with 1 = normal and 5 = severely lame. Results for temperature (°C) and locomotion scores (mean (SD)) are reported on Table 1. CB temperatures were higher for all types of hoof lesion ($P < 0.05$) than for healthy hooves. S temperature was higher for WLD ($P < 0.01$) compared with healthy hooves. ΔT (temperature difference between coronary band and skin) was higher ($P < 0.01$) in SU hooves than healthy hooves. Locomotion scores (LS) were similar to healthy cows for all groups except for WLD cows ($P < 0.01$). These results indicate that IRT has potential as a method for detection of hoof lesions, but further research is needed.

Table 1.

Lesion	CB Temp	Skin Temp	ΔT	LS
WLD	34.1(2.3)*	33.2(2.0)**	0.9(0.9)	3.0(0.8)**
SU	33.8(1.6)*	31.6(2.3)	2.1(0.8)**	3.0(0.9)
DD	33.1(1.6)*	31.9(1.5)	1.2(0.7)	2.4(0.7)
Healthy	32.6(1.9)	31.5(1.7)	1.1(0.9)	2.2(0.7)

*$P < 0.05$; **$P < 0.01$ (within column).

Key Words: lameness, thermography, hoof lesions

859 Relationship between udder and leg hygiene score and somatic cell count. M. Q. Shahid*, E. M. Shane, and M. I. Endres, *University of Minnesota*, *St. Paul*.

The objective of this prospective observational study was to evaluate the relationship between cow hygiene and somatic cell count. In addition, the association between milk production and somatic cell count was investigated. Five commercial dairy herds with sand bedded freestalls were used. Herd size ranged from approximately 450 to 1500 lactating cows. Cows were enrolled in the study during January and February 2008. Composite lower rear leg and udder hygiene scores (scale of 1 to 5, with 1 = clean and 5 = very dirty) were collected from approximately 4100 cows during 4 visits spaced 3 mo apart. Scores were recorded and determined by one individual throughout the entire study. Monthly somatic cell count (SCC) values were collected during each visit. Data were analyzed in a model that included effects of animal, sampling period, somatic cell scores (SCS), parity and DIM. The relationship between SCS and hygiene scores was analyzed using PROC MIXED analysis. Hygiene scores (LSMean (SE)) were 2.78 (0.58). Mean SCC and SCS were 294,000 (828,000) cells/ml and 2.76 (1.98), respectively. The analysis indicated that an increase in hygiene scores was associated ($P < 0.0001$) with an increase in SCS. The regression coefficient for SCS and hygiene score was 0.17. A unit increase in hygiene score was associated with a 59,000 cells/ml increase in somatic cell count. The other variables which were significantly associated with SCS were parity, DIM and total milk yield ($P < 0.0001$). Daily milk yield was 39.0 (11.6) kg/cow. The regression coefficient of SCS with parity, DIM and milk yield were 0.35, 0.002 and −0.019, respectively. Every 9,700 cells/ml increase in somatic cell count was associated with a 1 kg reduction in milk yield. Results of this study indicate that striving to maintain cows cleaner can contribute to improved milk quality and milk yield in freestall housed dairy herds.

Key Words: milk quality, SCC, hygiene

861 Association between stall surface and various welfare measurements on dairy herds utilizing recycled manure solids for bedding freestalls. A. W. Husfeldt* and M. I. Endres, *University of Minnesota*, *St. Paul*.

The objective of this observational study was to investigate the association between stall surface and various animal welfare measurements on dairy operations that utilize recycled manure solids as bedding material. The study included 34 dairy operations with herd sizes ranging from 100 to 3800 lactating cows. Forty 5 percent of the herds had mattresses and 55% percent had deep bedded stalls. Farms were visited once between July and October 2009. Approximately 50% of the lactating herd was scored for hygiene (scale of 1 to 5 with 1 = clean, 5 = very dirty), hock lesion prevalence (scale of 1 to 3, with 1 = no lesion, 2 = hair loss, 3 = swollen hock) and lameness prevalence. Lameness prevalence was evaluated by locomotion scoring (1 = normal locomotion, 5 = severely lame; ≥ 3 = lame). Hygiene scores (mean(SD)) were 2.6(0.3), hock lesion prevalence was 60.1(20.8) percent, and severe hock lesion (score 3) was 10.5(8.8). Lameness prevalence was 16.1(9.9) percent and severe lameness prevalence (score 4 and 5) was 5.2(5.0) percent. Hygiene scores (LSmean(SE)) for mattress and deep bedded herds were 2.6(0.05) and 2.5(0.04), respectively. There was an association ($P = 0.05$) with stall surface. Hock lesion prevalences (score 2 and 3) for mattress and deep bedded herds were 63.8(2.5) and 46.7(1.9) percent, respectively. There was an association ($P < 0.001$) between stall surface and hock lesion prevalence. Severe hock lesion prevalences (score 3) were 14.0(1.0) and 6.6(0.7) percent for mattress and deep bedded freestalls, respectively. Stall surface was associated ($P < 0.001$) with severe hock lesion prevalence. Lameness prevalences were 20.6(1.1) and 16.7(0.8) percent for mattress and deep beds, respectively. Stall surface was associated with lameness prevalence ($P < 0.001$). Severe lameness prevalences (scores 4 and 5) for mattress and deep bedded stalls were 6.5(0.5) and 5.1(0.4) percent, respectively and they were also associated with stall surface ($P = 0.04$). Based on these results it appears that deep bedded freestalls with recycled manure solids provide better animal welfare than recycled solids on top of mattresses.

Key Words: welfare, lameness, stall surface

862 Shade utilization and distribution of dairy cows in response to environmental conditions. A. L. Adams*, T. H. Friend, G. A. Holub, S. M. Garey, and C. L. Terrill, *Texas A&M University*, *College Station*.

The means by which dairy cows respond to heat stress is important to cow comfort. The objective of this study was to determine the effects of environmental conditions on shade utilization and pen distribution of cows. Three pens of dairy cows, averaging 186 cows per pen, were

observed for 72 consecutive hours during one trial in June and one trial in August in the Texas panhandle. The number of cows standing or lying in the shade, open lot, and at the bunk was recorded at 1 h intervals. Environmental conditions were also recorded. Soil temperatures at 5.1 cm below the surface were recorded every hour in transects starting under the shade structure and continuing 3.0 m, 6.1 m, 9.1 m, and 12.2 m from the eastern and western sides of the shade structure. Cow locations and shade use were analyzed in a mixed model. A significant increase in shade utilization occurred at 1200 – 1400 h ($P < 0.0001$). Shade utilization increased as cloud cover decreased ($P = 0.011$), wind speed decreased ($P = 0.0034$), and black globe temperatures increased ($P = 0.025$). Temperature-humidity index (THI) did not have a significant effect on shade use ($P = 0.19$). When black globe temperatures were high and the proportion of cows in the shade increased, cows spent more time standing ($P = 0.054$; $P = 0.015$, respectively). Cloud cover ($P = 0.45$), THI ($P = 0.74$), and wind speed ($P = 0.96$) did not affect the proportion of cows standing. Cows spent the most time at the feed bunk at 1900 – 2000 h ($P = 0.0004$). When cloud cover and wind speed were high, cows spent more time at the feed bunk ($P < 0.0001$; $P = 0.005$, respectively). Cows tended to spend more time at the feed bunk when THI was low ($P = 0.076$), but black globe temperatures did not have an effect ($P = 0.97$). Soil temperatures under the shade structures were consistently cooler than soil temperatures in the lots and were negatively related to the proportion of cows lying in the shade. These results suggest that multiple environmental parameters need to be considered when determining the comfort and well-being of dairy cows.

Key Words: dairy, behavior, heat stress

863   Associations between housing systems and animal welfare measurements assessed by survival analysis.   K. M. Lobeck*, M. I. Endres, S. M. Godden, and J. Fetrow, *University of Minnesota*, *St. Paul*.

The objective of this study was to determine when dairy cattle become lame in cross-ventilated (CV) freestall barns compared with naturally ventilated (NV) freestall barns. Data were collected from October 2007 to August 2009 on 4 commercial herds. Twenty-five cows were enrolled per season at calving time starting from fall 2007 until summer 2008 for a total of 100 cows per farm. Cows were enrolled in the study for an entire lactation or up to 1 year. Cows were scored every 2 mo for BCS (scale of 1 to 5 with 1 = thin, 5 = obese), hock lesion (scale of 1 to 3, with 1 = no lesion, 2 = hair loss, 3 = swollen hock) and lameness. Lameness was evaluated by locomotion scoring (1 = normal locomotion, 5 = severely lame; ≥ 3 = lame). CV animals reached median cumulative lameness incidence at 360 DIM, whereas NV animals reached median cumulative lameness incidence at 328 DIM ($P < 0.001$). Cows housed in NV barns were 2.9 times more likely to become lame than those housed in CV barns ($P < 0.001$). Each additional parity was associated with a 32% increase in the hazard of becoming lame ($P = 0.002$). Each additional 0.25 increase in body condition score resulted in a 7% decrease in hazard of becoming lame ($P = 0.03$). Cows that calved summer 2008, winter 2008, and spring 2008 were 7.3 times, 5.5 times, and 4.7 times ($P < 0.001$) more likely to become lame than fall 2007 cows, respectively. Cows that calved summer 2008 were 1.6 times more likely to become lame than those that calved spring 2008 ($P = 0.006$). For severe lameness (score 4 and 5), cows housed in NV barns were 2.2 times more likely to become lame than NV barns ($P = 0.03$). There was a trend for parity to increase the hazard of becoming lame by 27% ($P = 0.06$). There was also a trend for cows with hock lesions to be 1.9 times more likely to be lame than those without any hock lesion ($P = 0.09$). There was no difference between NV and CV barns for hock lesion incidence. Parity

was associated with a 14% increase in hazard of having a hock lesion ($P = 0.001$). These results indicate that animals housed in CV barns were less likely to become lame than those housed in NV barns, however, there were no differences in hock lesion incidence.

Key Words: lameness, welfare, hock lesion

864   Feed management practices on California dairies.   N. Silva-del-Río*[1], J. M. Heguy[2], and A. Lago[3], [1]*University of California Cooperative Extension*, *Tulare County,* [2]*University of California Cooperative Extension*, *Stanislaus and San Joaquin Counties,* [3]*APC, Inc, Ankeny, IA*.

The aim of this study was to obtain information on current feed management practices for the high milk yield pens on California′s Central Valley dairies. In summer 2009, a feed management survey was mailed to dairy producers in Tulare, Stanislaus, and San Joaquin counties; the first, third, and seventh largest producing dairy counties in California, respectively. Producers received an envelope containing an invitation letter, a one-page survey, and a pre-paid return envelope. Response rate was 16.9% (120/710). Herd size ranged from 160 to 6,600 cows (median = 950). Dairies fed total mixed rations (TMR) once (28.8%), twice (64.0%), or 3 or more times daily (7.2%). Two dairies reported that TMR was fed 6 times per day. Feed was pushed daily between 1 and 4 times (47.7%), 5 and 8 times (42.4%), and 9 or more times (9.9%). Overall, 44.5% of the producers fed for refusals. Targeted refusals were: 2% or less (50.0%), 2 to 5% (34.0%), or more than 5% (16.0%). Refusals were fed to heifers on 79.6% of dairies. TMR particle length was evaluated in 57.2% of the dairies: weekly (19.2%), monthly (21.7%), and occasionally throughout the year (13.3%). In 2008, dairies reformulated the ration fed to high producing cows 1 to 3 times (30.1%), 4 to 6 times (28.8%), 7 to 9 times (6.8%), and 10 or more times (34.3%). Four dairies reported reformulating the ration at least 20 times. Thirty-nine dairies cited a single reason for ration reformulation: new forage analysis (n = 21), new feedstuff (n = 11), new DM results (n = 3), and price (n = 4). Most dairies (62.9%) indicated 2 or more reasons for reformulating diets. Feed management software is used in 39.3% of the dairies to track dry matter intake (n = 42), cost of errors by feeders (n = 36), cost of feed and ingredient order in the mixer (n = 33), feed delivery time (n = 24), and inventory (n = 23). Some dairies routinely evaluated feed efficiency (n = 53) and milk urea nitrogen (n = 31). Only 24 dairies reported having written feed management protocols. Although dairy owner and manager responses are subjective, survey results help us to identify areas where feed management can be improved, such as feed bunk management and record keeping.

Key Words: feeding management, survey, dairies

860   Relationship between environmental climate and physiologic response under stress conditions of dairy cows measured using thermal imaging in southeastern Sicily.   G. Azzaro[1], R. Petriglieri[1], R. Ben Younes[2], M. Caccamo*[1], S. Carpino[1], G. Cascone[3], A. D'Emilio[3], R. Mazzarella[3], and G. Licitra[1,4], [1]*CoRFiLaC, Regione Siciliana*, *Ragusa, Italy*, [2]*Production Animale, Institut National Agronomique de Tunisie, Tunisia*, [3]*DIA, Catania University, Catania, Italy*, [4]*DACPA, Catania University, Catania, Italy*.

The influence of heat stress and physiologic response of dairy cows on performance have been reported in several studies. This study was part of a wider experiment aiming to assess the influence of the combination of environmental climate and floor material on physiological and productive performance of dairy cows. Thirty lactating dairy cows (137 ± 60 DIM; 38.26 ± 6.8 Kg/d milk yield) in a Sicilian herd were grouped

based on milk yield level and lactation stage. Cows in each group were randomly assigned to 2-level treatment of floor (concrete vs rubber) in the alleys in the barn and observed from June through September 2009 under heat stress condition. During this period, temperature humidity index (THI) was measured every 30 min using a thermologger. The physiological response to heat stress was measured every 2 weeks at 3 p.m. in terms of rectal temperature (RT) and respiratory rate (RR). At the same time, temperature of the entire body surface (BS), muzzle (MS), eyes (ES), and rump (RS) were measured using digital infrared thermal imaging. To capture thermal images of the entire body surface, cows were constrained ahead a panel cooled with water. The entire body surface was automatically selected through binarization using ImageJ software, whereas rump, eyes, and muzzle areas were manually selected from pictures. Daily average THI was highly correlated with RT and RR (0.57 and 0.48, respectively), whereas the highest correlation was with BS and RS (0.79 and 0.71, respectively). Both MS and ES were not correlated. Moderate correlations were found between RT and RR with BS (0.47 and 0.45, respectively). Same results were found for RS. No correlation was found between RT and RR with MS, whereas ES had a low ($P < 0.05$) correlation. The high correlation found in this study between BS with environmental temperature and physiologic response of cows makes the thermal imaging method on the entire body surface a promising non-invasive technique to assess heat stress effect.

Key Words: heat stress, body temperature, thermal imaging