Production, Management and the Environment: Measuring and Evaluating Environmental Stress

79 Dairy cows and the environment: Were we better off 83 years ago? A. D. Garcia*[1] and J. G. Linn[2], [1]*South Dakota State University*, *Brookings*, [2]*University of Minnesota*, *St. Paul*.

Concerns on the environmental impact of dairy cattle have increased recently. There's been unsubstantiated speculation that current emissions from dairy cows are far worse than in the past. This paper compares the environmental impact of dairy cows early in the 1920's with those in 2007.

In 1924 there were 12 million more dairy cows in the U.S. than in 2007. In spite of this, yearly milk production was 43.7 million kg less as production per cow was 1,892 kg per lactation (NASS). According to Hopkins (JDS 2:208), of 595 farms surveyed 62% grazed their cows 6 months of the year. Grazed and confined cows were fed a yearly average of 1 Ton of silage, 1.9 Ton of forage, and 1 Ton of grain DM.

In the 1920's the U.S. dairy herd was more breed diverse, with the first true-type for Holsteins not developed until 1922. Haecker et al. (Minn. Agr. Exp. Sta. Bul. 140, 79 p.), used 454 kg as a cow's average body weight with feeding standards aimed to maintain it. Cows were thus fed on average 3,541 kg of dry feed, produced 1,898 kg of milk yearly, with a feed efficiency of 0.52 kg milk/kg feed. Using the Ellis et al. (JDS 90:3456) model to predict methane emissions based on daily DM intake, a dairy cow in the 1920's consuming 9.7 kg would emit 11.1 MJ of methane/d.

In 2007, there were 9.15 million dairy cows in the US producing on average 9,196 kg of milk yearly. A national summary on feed amounts and types being used on today's dairy farms is not available. Assuming an efficiency of 1.5 kg milk/kg feed DM and a DM intake of 12.7 kg/d for 60 days dry, the average daily DM intake over 365 days for a dairy cow in 2007 would be about 18.9 kg/d. Using the Ellis et al. model, the average cow emitted 18.5 MJ methane/d. This is a methane emission of 0.73 MJ/kg milk compared to 2.14 MJ/kg milk for cows in the 1920's. The reduction of 12 million dairy cows since 1924 results in total methane emissions reduction of 68.4 million MJ/d, or 39% less methane from dairy cows today than in 1920's. In addition, feed efficiency has increased three-fold over the last 8 decades.

Key Words: Methane, Dairy, Environment

80 Impact of using feedline soakers in combination with Korral Kools® to cool early lactation cows housed in desert style barns. J. F. Smith*[1], B. J. Bradford[1], A. Oddy[2], J. P. Harner[1], and M. J. Brouk[1], [1]*Kansas State University*, *Manhattan*, [2]*NADA Al-Othman*, *Al Ahsa, Saudi Arabia*.

An experiment was conducted at a dairy located in Saudi Arabia in September 2007 to evaluate the impact of feedline soakers, in combination with Korral Kools®, on the body temperature of early lactation cows. Feedline soakers were installed in two pens of cows. The feedline soakers were set to come on at a barn temperature of 21°C with a soaking frequency of 5 min (36 s on and 264 s off). Korral Kools® were spaced every 6 m over the resting area and were operated, with the fans coming on at a barn temperature of 27°C and the water at 30°C. Feedline soakers were alternately turned on and off for 24 h periods over 4 d. Hourly ambient temperature, humidity and temperature-humidity index (THI) were collected from a weather station located on the dairy. Vaginal temperatures of 7 primiparous (53 d in milk, 41.2 kg/d milk production) and 6 multiparous cows (28 d in milk, 48.1 kg/d milk production, 2.8 lactations), located in separate groups, were collected every 5 min using data loggers (HOBO U12) attached to a blank CIDR. Vaginal temperature data was analyzed with a mixed model including fixed effects of pen, treatment, day within treatment, time of day, and treatment by time of day interaction, and the random effect of cow within pen. Repeated measures over time were modeled with a variance component covariance structure, and denominator degrees of freedom were estimated using the Kenward-Roger method. Ambient temperature during the trial was 29.7°C (range: 21.7 to 38.5°C), relative humidity was 44.4% (16 to 85%) and THI was 75.6 (68 to 82). Feedline soakers significantly decreased mean 24-h vaginal temperatures from 38.98 to 38.80°C ($P < 0.001$). Treatment by time interaction was also significant ($P < 0.001$), with greatest treatment effects during peak heat stress; feedline soakers reduced vaginal temperatures from 39.72 to 39.42°C at 2400 h and from 39.32 to 38.98°C at 500 h. Additional research is needed to determine how to operate the Korral Kool® sytem with feedline soakers.

Key Words: Heat Stress, Dairy Cattle, Cooling

81 Impact of using evaporative pads and fans in combination with feedline soakers to reduce heat stress of prepartum cows. J. F. Smith*, B. J. Bradford, J. P. Harner, and M. J. Brouk, *Kansas State University*, *Manhattan*.

An experiment was conducted at the KSU dairy in August 2007 to evaluate the impact of evaporative pads and fans, in combination with feedline soakers, on the body temperature of prepartum cows. To complete this trial, an addition was constructed to the maternity barn to incorporate the use of evaporative pads and fans to cool the bedded pack area. Evaporative pads were alternately turned on and off for 24 h periods over 4 days. When the pads were on, water was circulated through the evaporative pads from 830 h to 230 h. The fans pulling air through the evaporative pads were operated anytime the barn temperature was above 21°C. The feedline soakers were set to come on at a barn temperature of 21°C with a soaking frequency of 15 min (5 min on and 10 min off). Logging devices collected ambient temperature and relative humidity data at 15-min intervals. Vaginal temperatures of 8 cows located in the same group were collected every 5 min using data loggers (HOBO U12) attached to a blank CIDR. Vaginal temperature data was analyzed with a mixed model including fixed effects of treatment, time of day, and treatment by time of day interaction, and the random effects of cow and day within treatment. Repeated measures were modeled with a variance component covariance structure, and denominator degrees of freedom were estimated using the Kenward-Roger method. Evaporative cooling significantly decreased mean 24-h barn temperature by 3.8°C and temperature-humidity index (THI) by 2.3 units. The greatest differences in barn temperature and THI occurred at 1700 h, when temperature was reduced by 6.8°C and THI by 3.1 units. Evaporative cooling significantly decreased mean 24-h vaginal temperatures from 38.95 to 38.79°C ($P < 0.001$). The treatment by time interaction was also significant ($P < 0.001$), with the greatest treatment effects during peak heat stress times (39.2 vs. 38.9°C at 1500 h, 39.3 vs. 39.1°C at 2300 h for pads off and

on, respectively). Evaporative cooling in combination with feedline soakers can be used to reduce body temperatures of prepartum cows experiencing heat stress.

Key Words: Heat Stress, Dairy Cattle, Transition Period

82 Differences in thermoregulatory ability between slick and normal–haired lactating Holstein cows in response to acute heat stress. S. Dikmen*[1,2], E. Alava[2], E. Pontes[3], J. M. Fear[2], B. Y. Dikmen[4], T. A. Olson[2], and P. J. Hansen[2], [1]*University of Uludag*, *Bursa, Turkey*, [2]*University of Florida*, *Gainesville, FL, USA*, [3]*Universidade de São Paulo*, *São Paulo, Brazil*, [4]*University of Uludag, Keles Vocational School*, *Keles, Bursa, Turkey*.

The slick gene is a major dominant gene in cattle that controls hair growth. The aim of this study was to determine whether slick-haired Holsteins are better able to regulate vaginal (VT) and skin temperature (ST), respiration rate (RR) and sweating rate (SR) than normal-haired Holsteins during exposure to an acute increase in heat stress. Lactating slick and normal-haired cows were kept in one of two environments: an indoor environment (n=10) with fans and evaporative cooling and an outdoor environment (n=10) only with shade cloth. VT, RR, ST and SR were measured at 1200, 1500, 1800 and 2100 h and blood samples were collected for plasma cortisol concentrations. Cows in the outdoor environment had higher VT, ST, SR and RR than cows in the indoor environment (P<0.001). VT was lower (P=0.05) in slick-haired animals in both environments. The least-squares means ± SEM for VT at 1200, 1500, 1800 and 2100 h were 39.4±0.1 vs 39.9±0.1, 39.7±0.1 vs 40.0±0.1, 39.8±0.1 vs 40.3±0.1, 39.4±0.1 vs 40.0±0.1°C for slick vs normal, respectively, in the outdoor environment and 38.8±0.1 vs 39.0±0.1, 38.5±0.1 vs 38.9±0.1, 38.8±0.1 vs 39.0±0.1, 38.5±0.1 vs 38.9±0.1°C for slick vs normal in the indoor environment. SR tended to be higher for slick-haired cows in both environments (P=0.07). The least-squares means ± SEM for SR at 1200, 1500, 1800 and 2100 h were 113.6±6.5 vs 88.6±6.5, 93.5±6.5 vs 75.2±6.5, 90.2±6.5 vs 82.0±6.5, 25.1±6.5 vs 24.7±6.5 g/hm^2 for slick vs normal, respectively, in the outdoor environment and 70.4±6.5 vs 60.1±6.5, 52.7±6.5 vs 37.3±6.5, 47.7±6.5 vs 55.2±6.5, 14.5±6.5 vs 16.8±6.5 g/hm^2 for slick vs normal in the indoor environment. RR was lower for slick-haired cows in both environments (P<0.05). There was no difference in ST between hair type and cortisol concentrations were not affected by environment or hair type. Results indicate that slick-haired cows can regulate their body temperature more effectively than normal cows during heat stress. The superior thermotolerance of the slick-haired cows is likely to reflect increased heat loss via conduction and convection as well as increased SR.

Key Words: Heat Stress, Holstein, Slick Hair Gene

83 Development of models for predicting management practices and conditions that alleviate heat stress in large commercial dairy farms. J. M. Schefers*, K. A. Weigel, and N. B. Cook, *University of Wisconsin*, *Madison*.

During the summer of 2007, 29 dairy herds in the Alta Advantage® progeny testing program were selected to participate in a heat stress study to determine the importance of different types of heat abatement systems and facility designs for alleviating heat stress in lactating dairy cows. For each herd, intravaginal temperatures were recorded from lactating cows using a continuous temperature logging device (HOBO®) attached to a blank intravaginal insert (CIDR). The observational period was 39 hr, and temperatures (° Celsius) were recorded at 2-min intervals. The temperature data loggers were inserted in 7 to 8 early lactation cows per herd. Ambient temperature (° Celsius) and relative humidity were collected at 2-min intervals over the same 39-hr period as the temperature data loggers in the freestall barns on each dairy. Overall, 16 variables related to facilities and heat abatement systems were considered in this study. Mean intravaginal cow temperature was calculated for each lactating cow from the temperature data logging devices over the 39-hr observational period. Mean intravaginal cow temperature was used to calculate the mean herd temperature for each herd participating in the study. Mean temperature humidity index (THI) was the most significant predictor (P < 0.01) of mean herd temperature for herds that participated in the heat stress study. As THI increases, mean herd temperature also increases. Also, mean herd temperature was significantly higher (P < 0.05) for dairy herds that had a north-south (NS) orientated barn than herds with barns orientated in the east-west (EW) direction. Least squares means were 38.97°C and 38.84°C for the NS orientated barns and EW orientated barns, respectively. Furthermore, the holding pen was identified as a major risk area for heat stress. Airflow in cubic feet per minute per cow (cfm/cow) and stocking densities in the holding area were both found to be significant at P < 0.05. As the airflow rate in cfm/cow increased, there was a significant decrease in mean herd temperature and as stocking densities increased, cows got hotter.

Key Words: Heat Stress, Dairy Cattle, Environment

84 Is the temperature–humidity index (THI) the best indicator of heat stress in lactating dairy cows in a subtropical environment? S. Dikmen*[1,2] and P. J. Hansen[2], [1]*University of Uludag, Faculty of Veterinary Medicine*, *Bursa, Turkey*, [2]*University of Florida*, *Gainesville*.

Several temperature–humidity indexes (THI) have been developed to estimate the degree of thermal stress experienced by mammals. THI's are based on formulae that include meteorological variables related to air temperature and humidity. Many of these were originally derived for species other than cattle and many were not derived by performing regression analysis to estimate the optimal weighting of temperature and humidity. The objective of this study was to develop an equation using meteorological variables that best predicted rectal temperature of lactating cows in a subtropical environment and compare the accuracy of prediction of rectal temperature of this equation to that obtained using dry bulb temperature (DBT), 7 different THIs, and DBT or THI in combination with other meteorological variables. Rectal temperature was measured between 1500 and 1700 h in 1280 lactating Holstein cows in north central Florida. Dry bulb temperature, relative humidity (RH), black globe temperature (BGT), dew point, and wind speed were recorded at each cow's location. Data were recorded from August to December 2007. Regression analysis to predict rectal temperature was performed using various models that included parity, stage of lactation, farm, milk yield, the meteorological variables mentioned above as well as seven separate THIs. Stepwise regression analyses were performed to identify equations with highest coefficient of determination (r^2) for predicting rectal temperature. The r^2 using DBT (0.407) was similar to that for models using THI (r^2 between 0.420 and 0.425) or BGT (r^2=0.389). The r^2 for equations using DBT could be improved by adding RH (r^2=0.428) or RH and RH^2 (r^2=0.437) to the model. In conclusion, DBT is nearly as good a predictor of body temperature of lactating

Holsteins in a subtropical environment as THI and inclusion of RH in the model results in r^2 as good as THI.

Key Words: Heat Stress, Temperature–Humidity Index

85 Evaluation of accuracy and variation of Thermochron® iButtons®. S. M. Garey*, T. H. Friend, and B. H. Carter, *Texas A&M University*, *College Station*.

The Thermochron iButton DS1921H temperature logger has been useful in a wide range of biological studies. The objective of this study was to determine if the accuracy or variability of these devices change as they age or when they are used over a range of temperatures. Individual iButtons were grouped into new (4000 to 6000, n=11) and old (32000 to 35000, n=12) categories by number of lifetime readings. The iButtons were exposed for 1 h to 20°C, 30°C, 38°C and 44°C in a thermostatically controlled water bath in ascending order, and the temperature treatments were subsequently replicated in descending order. After the iButtons stabilized at each temperature, 60 readings at 1–min intervals per iButton were evaluated for accuracy against a calibrated certified thermometer (accuracy 0.1±0.05°C) by calculating the average mean of the differences at each reading. The variation of each iButton was then compared using the standard deviation of those differences. The effect of age on deviation from the certified thermometer was determined using independent t–tests. Overall, the new iButtons were more accurate ($P < 0.01$), differing from the certified thermometer by –0.26°C, while the old iButtons differed by –0.46°C. Additionally, new iButtons had a tendency ($P < 0.05$) to be less variable with a mean SD of 0.07°C, versus 0.09°C for old iButtons. The performance of the iButtons in different temperatures was analyzed using paired t–tests with a Bonferroni correction. As the temperature increased, the accuracy of the iButtons improved ($P < 0.01$) with average differences of –0.41°C at 20°C, –0.40°C at 30°C, –0.36°C at 38°C and –0.31°C at 44°C. These results suggest that data collected with these devices, regardless of age, should be individually corrected to a standard reference for cross–study comparison. Alternatively, a correction to a group mean by allowing the iButtons to equilibrate in a temperature range similar to that in which it will be used will improve within–study comparisons.

Key Words: Thermochron, iButton, Temperature

86 Addition of skin temperature to whole body temperature measures improves relationship to Temperature Humidity Index under moderate climatic conditions. R. B. Zimbelman*, J. B. Wheelock, M. D. O'Brien, J. Muumba, A. Alex, R. P. Rhoads, L. H. Baumgard, and R. J. Collier, *University of Arizona*, *Tucson*.

The Temperature Humidity Index originally developed by Thom (1958) and extended to cattle by Berry and colleagues (1964) is used to estimate cooling requirements of dairy cattle. However, correlation of THI to measurements of core body temperature is not adequate. Our objective was to determine if incorporation of skin surface temperature to mean body temperature measures would improve Pearson Correlation Coefficients between THI and physiological measures of heat stress. During a three-month span, three groups of cows (n=12) were housed in the environmental chambers at the University of Arizona for a total of 22 days. Each group experienced a total of three environments where THI was at a minimum of 49, maximum of 79 and an average 62.9. We utilized NRC 1971 THI calculation (0.18 x Tdb+32) x (0.55-(0.0055 x RH) x (1.8 x Tdb-26) for estimate of environmental heat load. Physiological measures of heat strain included respiration rate (RR/min), infrared surface temperature (ST, °C), rectal temperature (RT. °C), heart rate (HR/min), and evaporative heat loss (EVHL, g/m2). Mean body temperature (BT, °C) was calculated using the formula BT = (0.33 x ST+0 .67 x RT). Respiration rates, ST, RT, EVHL, and HR were routinely collected 4 times per day and hourly for 24 hours once biweekly for a total of 2096 measures. Correlations of these measures to THI were as follows: THI and RR ($r=0.63$; $P<0.0001$), THI and RT ($r=0.42$; $P<0.0001$), THI and SR ($r=0.64$; $P<0.0001$), THI and ST ($r=0.0.86$; $P<0.0001$), THI and BT ($r=0.85$; $P<0.0001$), and THI and HR ($r= -0.45$; $P<0.05$). Correlations between BT and RR ($r=0.48$; $P<0.0001$), BT and SR ($r=0.69$; $P<0.0001$), BT and RT ($r= 0.63$; $P<0.0001$). We conclude that under moderate climatic THI conditions investigated addition of ST to BT improved the correlation of BT to THI over RT alone. In addition, the correlation of RR, ST, and BT are improved over RT alone implying that ST has a greater effect on RR than RT.

Key Words: Temperature Humidity Index, Skin Temperature, Body Temperature

87 Facility characteristics of U.S. dairy operations and their impact on cow health and productivity. J. E. Lombard*[1], C. B. Tucker[2], M. A. G. von Keyserlingk[3], and C. A. Kopral[1], [1]*USDA:APHIS:VS:Centers for Epidemiology and Animal Health*, *Fort Collins, CO*, [2]*University of California*, *Davis, CA*, [3]*Animal Welfare Program, University of British Columbia*, *Vancouver, BC, Canada*.

Assessments and questionnaires were administered to evaluate cow health, productivity and facility characteristics on 491 dairy operations in the top 17 dairy states as part of the USDA's National Animal Health Monitoring System's Dairy 2007 study. The objectives of this portion of the study were to quantify characteristics of cow housing and how these features correspond with cow health and productivity on U.S. dairy operations. Data were collected from March through August 2007. The percentage of operations assessed by housing types were tiestall (39.0%), stanchion (13.0%), freestall (38.4%), drylot (5.0%) and other multiple animal areas (4.6%). Stanchion barns were the oldest with the mean building year of 1949 compared to freestall housing with a mean building year of 1989. Mean stall widths were widest for tiestalls (1.2 m) compared to stanchions or freestalls (both 1.1 m). In general, freestall operations had more bedding than tiestall and stanchion operations. Overall disease incidence, including hypocalcemia and displaced abomasum, was lowest on drylot operations compared to other housing systems. Operations with stanchion housing had lower cow removal rates compared to tiestall and freestall operations and a lower percentage of deaths compared to freestall operations. Rolling herd average milk production was higher for operations with tiestall (9647 kg) or freestall (9706 kg) housing compared to stanchion (7966 kg) or drylot (8065 kg) facilities. Facilities constructed in the last 20 years, such as freestall housing, have placed greater emphasis on cow comfort and may be associated with increased health and production compared to older facilities. However, results of this study indicate that freestall facilities are not associated with improved health compared to other housing systems, suggesting that further improvements in facility design and management must be identified.

Key Words: Housing, Health, Productivity

88 The effects of supplementing a dietary novel yeast culture on body temperature indices, production and metabolism in heat-stressed lactating cows. G. Shwartz[1], J. B. Wheelock[1], L. L. Hernandez[1], M. D. O'Brien[1], K. A. Dawson[2], M. J. VanBaale[1], R. P. Rhoads[1], R. B. Zimbelman[1], and L. H. Baumgard*[1], [1]*University of Arizona*, *Tucson*, [2]*Alltech Inc.*, *Nicholasville, KY*.

Multiparous, lactating Holstein cows (n= 23; 120±30 DIM, 690±67 kg BW) housed in climatic chambers were randomly assigned to 1 of 2 dietary treatments (TRT): a diet containing Yea-Sacc® HD (a formulated yeast culture for heat stress, n=12, 10 g/d) or control diet (n=11). The trial length was 28d and consisted of a 7d thermal-neutral acclimation period (18°C, 20% humidity) followed by 21d of heat stress (HS; cyclical daily temps ranging from 29.4 to 37.8°C and 20% humidity). Cows were individually fed a TMR consisting primarily of alfalfa hay and steam flaked corn. During acclimation, yeast supplementation had no effect on temperature or production variables. During HS, TRT had no effect on rump temperature, respiration rate, or sweating rates. Tail head (39.52 vs 39.24°C) and shoulder (39.59 vs 39.31°C) temperatures tended ($P<0.08$) to be higher for controls. Controls had increased ($P<0.05$) rectal temperature at 1200 and 1800 h (40.29 vs 40.02°C; 40.35 vs 40.12°C, respectively), and tended to be higher (39.48 vs 39.26°C; $P=0.05$) at 0600 h compared to yeast fed cows. There was no TRT effect on BW loss (58 kg) during HS. Although DMI decreased (29%) during HS, there was no TRT effect on intake. HS progressively decreased milk yield, reaching a nadir (33%) on the 3rd week, but TRT had no effect on milk yield (28.16 kg), 3.5% FCM (29.05 kg) or ECM (28.14 kg). Although TRT had no effect on milk composition, HS decreased ($P < 0.05$) protein (7%) and lactose (5%), but did not alter fat levels. HS cows were in negative EBAL (-1.0 Mcal/d), but TRT had no effect on EBAL or feed efficiency (1.71). Independent of TRT, HS decreased plasma glucose (11%), but neither TRT nor HS altered basal NEFA levels. PUN was increased (≥45%) and also tended to be lower in yeast-fed cows (13.5 vs 14.6 mg/dL; $P<0.10$). Despite yeast-fed cows having reduced body temperatures and PUN concentrations, production parameters were not improved during HS.

Key Words: Heat Stress, Yeast Culture

89 Effects of nutrition and feeding management on production, health and culling by organically-managed dairy herds in southeastern Pennsylvania. K. Griswold*[1], H. Karreman[2], S. Dinh[1], and J. High[3], [1]*Penn State Cooperative Extension*, *University Park, PA*, [2]*Penn Dutch Cow Care*, *Gap, PA*, [3]*Lancaster DHIA*, *Manheim, PA*.

The effects of nutrition and feeding management on production, health, and culling were examined using a combination of survey and DHIA data. Initially, 38 organically-managed (OM) herds using Lancaster DHIA services were recruited for the study, but only 29 herds returned completed surveys. The survey consisted of 308 questions concerning herd demographics, milk quality, health, reproduction, nutrition, and young stock. Monthly DHIA 202 report data from 2006 for each herd were used for the study. Data were analyzed using PROC MIXED and PROC REG within SAS. The supplemental forage model included the fixed effects of feeding haylage (HYL), baleage (BL), alfalfa hay (AH), mixed-grass hay (MGH), and corn silage (CS). The supplemental grain model included the fixed effects of feeding shelled corn (SC), high-moisture shelled corn (HMSC), ear corn (EC), high-moisture ear corn (HMEC), oats (OA), spelts (SP), soybean meal (SBM), and a grain mix (GM). LS means with standard errors are presented in the table below. The results indicate that herds feeding BL produced less milk with greater milk fat % and protein % compared to herds not feeding BL. Corn silage supplemented herds produced more milk than herds not receiving corn silage. Regression analysis revealed no significant ($P > 0.05$) relationship between level of CS supplementation and milk yield. Feeding oats significantly increased milk fat %, but milk fat yield (kg per cow per year) was not affected ($P = 0.91$). All other suuplements examined had no effects on milk yield and components ($P > 0.10$). Both herd cull rate % and death loss % were not affected ($P > 0.10$) by supplemental forage or grain choices. These results suggest that supplemental forage choice has more potential impact on milk production and components in OM dairy herds than supplemental grain choice. Supplementation of forage to enhance milk yield does not deleteriously affect culling and death loss in OM dairy herds.

Table 1. Effects of supplemental feeds on milk production in organically-managed dairy herds

	Milk yield, kg/cow/year		
Supplement	Yes	No	*P*
Corn Silage	7,837 ±341	6,501 ±479	0.0007
Baleage	6,594 ±481	7,745 ±364	0.008
Ear Corn	7,346 ±577	7,171 ±909	NS
Oats	7,035 ±1,033	7,482 ±1,020	NS
	Milk Fat %		
Supplement	Yes	No	*P*
Corn Silage	3.84 ±0.08	3.88 ±0.12	NS
Baleage	3.97 ±0.12	3.75 ±0.09	0.038
Ear Corn	3.63 ±0.17	3.90 ±0.12	0.084
Oats	3.87 ±0.14	3.65 ±0.14	0.037
	Milk Protein %		
Supplement	Yes	No	*P*
Corn Silage	3.06 ±0.06	3.11 ±0.08	NS
Baleage	3.18 ±0.08	3.00 ±0.06	0.01
Ear Corn	3.02 ±0.12	3.17 ±0.09	NS
Oats	3.15 ±0.10	3.05 ±0.10	NS

Key Words: Organic, Milk Yield, Nutrition

90 Identification of efficient sets of artificial insemination reproductive management programs: A stochastic dominance analysis. N. J. Olynk* and C. A. Wolf, *Michigan State University*, *Lansing*.

Reproductive success is critical to the financial success of the dairy farm. Several reproductive management technologies have been developed to aid in effective and efficient reproductive management. Farm managers have heterogeneous risk preferences. The riskiness of a program's outcome (i.e., range of potential conception or heat detection rates) and the risk preferences of the farm manager will affect technology adoption decisions. Further, on-farm costs and goals will affect the reproductive program chosen. The objective of this research was to identify optimal programs for farms with a given set of characteristics (e.g., manager characteristics, on-farm costs, goals). Stochastic dominance, a method to rank risky alternatives without specific information on decision maker preferences, was utilized to determine efficient sets of programs for farm managers with given risk preferences and for various on-farm cost scenarios. First degree stochastic dominance (FSD) identified the

efficient programs for decision makers who simply prefer 'more to less', or in this case prefer the program with lower total cost. Second degree stochastic dominance (SSD) compared programs based on relative riskiness, and identified the efficient programs for decision makers who prefer 'more to less' at a diminishing rate – and therefore are risk averse. Prior reproductive study results were used to parameterize the analysis of reproductive technologies including visual heat detection, Ovsynch, and Cosynch. No FSD was identified which highlights that no single reproductive program was preferred by all managers. SSD of Ovsynch over Cosynch was identified under given scenarios, indicating that risk averse managers would prefer Ovsynch over Cosynch. By identifying efficient sets of reproductive programs we can make better technology adoption recommendations to dairy farm operators and further understand why farms adopt specific reproductive technologies.

Key Words: Reproductive Management, Decision Support, Stochastic Dominance