Ruminant Nutrition
Silage and Intake

811 Endosperm type and kernel processing of corn silage: effects on short-term lactational performance in dairy cows. R. A. Longuski*[1], K. C. Fanning[2], M. S. Allen[1], R. J. Grant[2], and J. F. Beck[3], [1]*Michigan State University, East Lansing,* [2]*University of Nebraska, Lincoln,* [3]*Syngenta Seeds, Golden Valley, MN.*

Effects of kernel processing (rolling) and endosperm type (floury, vitreous) of corn silage on short-term lactational performance in dairy cows were evaluated at two sites (MI and NE). At each site, vitreous and floury corn silages were harvested just prior to black layer, and half of each hybrid was chopped at ∼1 cm TLC (not rolled) or ∼2 cm TLC with kernel processor (1-mm clearance). A replicated 4 x 4 Latin square with 28-d periods and a 2 x 2 factorial arrangement of treatments were used at both sites. Diets contained 42.6 to 45.9% and 32.0 to 35.1% corn silage at NE and MI, respectively. At NE, 12 Holstein cows (8 multiparous and ruminally fistulated) were used, and at MI eight ruminally fistulated, multiparous cows were used. Dry matter intake (DMI) decreased by rolling ($P < 0.01$) with a tendency ($P < 0.12$) for a greater reduction for floury (26.1 vs. 27.6 kg/d) than for vitreous (27.0 vs. 27.4 kg/d). This response was consistent across locations. There was a significant ($P < 0.01$) location by rolling interaction for milk yield and fat-corrected milk (FCM) yield; rolling increased milk yield by 3.4 kg/d and FCM by 2.7 kg/d at NE but had no effect on either at MI. Rolling decreased milk fat % for vitreous (3.44 vs. 3.68%) but not for floury across location. Body weight and body condition score were not affected by treatment. Efficiency of FCM production (FCM/ DMI) increased ($P < 0.04$) by 4.6% for floury versus vitreous and by 6% ($P < 0.01$) for rolled versus unrolled corn silage. No effect of endosperm type and no interaction between endosperm type and rolling was observed on yield of milk or milk components across locations. When formulating diets for lactating dairy cows, endosperm type and silage processing will affect efficiency of FCM production.

Key Words: Silage processing, Corn endosperm type, Lactational performance

812 Endosperm type and kernel processing of corn silage: effect on starch and fiber digestion and ruminal turnover in lactating dairy cows. K. C. Fanning*[1], R. A. Longuski[2], R. J. Grant[1], M. S. Allen[2], and J. F. Beck[3], [1]*University of Nebraska, Lincoln,* [2]*Michigan State University, East Lansing,* [3]*Syngenta Seeds, Golden Valley, MN.*

Effects of kernel processing (rolling) and endosperm type (floury, vitreous) of corn silage on starch and fiber digestion and ruminal turnover in lactating dairy cows were evaluated at two sites (MI and NE). At each site, vitreous and floury corn silages were harvested just prior to black layer, and half of each hybrid was chopped at ∼1 cm TLC (not rolled) or ∼2 cm TLC with kernel processor (1-mm clearance). A replicated 4 x 4 Latin square with 28-d periods and a 2 x 2 factorial arrangement of treatments were used at both sites. At NE, 12 Holstein cows (8 multiparous and ruminally fistulated) were used, and at MI eight ruminally fistulated, multiparous cows were used. At both sites, floury endosperm corn silage increased total tract digestibility of OM and starch ($P < 0.01$), and tended to increase NDF digestion ($P = 0.09$). Rolling increased starch digestion ($P < 0.01$) but reduced digestibility of NDF and OM ($P < 0.01$). There was no interaction of endosperm and rolling on total tract digestibility of OM, starch or fiber. Average ruminal pH, total VFA, and acetate to propionate ratio were unaffected by rolling or endosperm. Rolling increased ruminal digesta volume for the vitreous hybrid, but decreased volume for the floury hybrid. Ruminal turnover rates for OM, NDF, and starch were unaffected by treatment. Rumination and total chewing times were reduced ($P < 0.03$) for cows fed the vitreous compared with the floury hybrid but eating time was not affected by treatment. Total tract starch digestibility in lactating dairy cows can be improved by use of floury endosperm silages and silage processing. Greater ruminal starch digestion from rolling might decrease NDF digestibility. The modest response to endosperm type likely reflected the fact that <15% of the dietary DM was comprised of treatment starch.

Key Words: Silage processing, Corn endosperm type, Digestibility

813 The effect of corn silage particle size and cottonseed hulls on cows in early lactation. P.J. Kononoff*[1] and A.J. Heinrichs, [1]*The Pennsylvania State University.*

The objective of this study was to evaluate the effects of reducing corn silage particle length (PL) and the inclusion of cottonseed hulls (CSH) on intake, digestion, chewing activities and milk production. Sixteen cannulated, multiparous cows averaging 17 DIM and 677 kg BW were assigned to one of four 4X4 Latin Squares. One square contained rumen cannulated cows to evaluate effects of treatment on rumen fermentation and function. During each of the 23 d periods animals were offered one of four TMR#s that differed in forage PL (long or short corn silage) and CSH inclusion rate (0 or 8% DM). Dietary treatments were as follows: long no CSH (LGNH), long with CSH (LGH), short no CSH (SHNH), and short with CSH (SHH). Total physically effective NDF, measured as percent of NDF greater than 1.18 mm, was similar across diets (31.3, 32.4, 32.0, 30.6 for LGNH, LGH, SHNH, and SHH respectively) but mean particle length decreased with reducing PL and inclusion of CSH (7.9, 6.8, 6.8, 6.1 mm). Dry matter intake was not significantly affected by PL but was significantly increased with the inclusion of CSH. Decreasing PL and the inclusion of CSH significantly increased neutral detergent fiber intake (NDFI). Total chewing activity expressed as minutes per day was unaffected by PL and the inclusion of CSH. Both eating and ruminating efficiency expressed as minutes per kilogram of NDFI increased with increasing PL and decreased with the inclusion of CSH. Milk production did not differ across treatments; but the inclusion of CSH significantly increased percent protein. Reducing forage PL tended to reduce percent milk fat. Mean ruminal pH was not affected by PL but was highest on diets containing CSH even though no treatment effects were observed on total VFA, acetate, or propionate concentration. These results indicate that corn silage PL is a poor predictor of total chewing time and rumen pH but is useful in understanding factors affecting feeding behavior. Additionally, the inclusion of CSH resulted in increased rumination and mean rumen pH even though effects of VFA concentration were not observed.

Key Words: forage particle length, cottonseed hulls, chewing activity

814 Effects of brown midrib 3 mutation of corn silage on feed intake and ruminal adaptation of Holstein cows during the peri-parturient period. Y. Ying* and M. S. Allen, *Michigan State University, East Lansing.*

Thirty-one cows were alternately assigned to treatment diets containing either brown midrib (bm3) corn silage or its isogenic normal control silage at 28 ± 3 d prior to estimated calving date. Diets were formulated to 33% NDF and 14% crude protein with corn silage at approximately 57% of dietary DM. Twenty-three cows received treatment diets at least 21 d and were used for analysis. All cows were switched to a common diet formulated to 28% NDF and 19% CP at calving for 56 ± 3 d. Ruminal capacity, pH, papillae size and digestibility were measured weekly until 7 ± 3 DIM. DMI and milk yield were measured daily until 56 DIM and milk components were measured weekly. Bm3 significantly increased digestibility of NDF (43.0 vs. 33.9%, $P < 0.01$), decreased digestibility of starch (91.6 vs. 94.1%, $P < 0.01$) but did not affect digestibility of DM or OM before calving. Treatments did not affect DMI, digestible DMI or change in BW or BCS before or after calving. Rumen pool sizes were not affected by treatment. Ruminal turnover time for NDF tended ($P = 0.11$) to be reduced for bm3 treatment one week prior to calving but DMI was not affected. Ruminal pH averaged 6.48 before calving and was not affected by bm3 treatment or by week on treatment. Ruminal papillae surface area increased during the treatment period and rate of growth was greater for bm3 treatment relative to control. Although papillae surface area was greater for bm3 compared to control at 7 DIM, no treatment effects were observed for ruminal pH or rate of valerate absorption from the rumen, and total VFA concentration tended to be greater for bm3 treatment (127.1 vs. 113.8 mM, $P = 0.06$). Treatments before calving did not affect digestibility of DM, OM, NDF, or starch, at 7 DIM or DMI or yield of milk or FCM through 56 DIM. Results of this experiment suggest that feed intake was not limited by ruminal fill before calving and that rate of VFA absorption immediately after calving was not affected by adaptation of ruminal papillae.

Key Words: bm3 corn silage, peri-parturient period, feed intake

815 Influence of non-fibrous carbohydrates on milk production and composition of cows fed fescue silage. D.J.R. Cherney*, J.H. Cherney, and L.E. Chase, *Cornell University, Ithaca, NY.*

There is interest in knowing if source of non-fibrous carbohydrates (NFC) influences milk production and composition. Our objective was to determine the effects of source (starch or sugar) and level of NFC in the diet on these parameters. A 4x4 Latin square replicated five times using early-lactation (56 ± 9 days in milk) Holstein cows was used, cows being offered one of two levels of NFC and either no added sugar or sugar substituting for 10% of the corn. Diets were balanced to meet NRC requirements for total protein, energy, and minerals. Tall fescue silage was included at one of two levels (0.95% or 1.25% of body weight as forage neutral detergent fiber (NDF)), resulting in diets with 40% and 30% NFC. Remaining ingredients consisted of high-moisture corn, soybean meal, SoyPlus #, minerals and vitamins. By-pass fat (0.45 kg/d) was used in the low NFC diets. High NFC diets were lower ($P<0.01$) in NDF (31.5%) and crude protein (CP; 19.6%) than the low NFC diet (35.8% NDF and 21.0% CP). Sugar containing diets were somewhat lower ($P<0.01$) in NDF (33.1%) than the no sugar added diets (34.3%), but diets did not differ in CP%. Cows offered the high NFC level produced more milk (40.1 kg/d; $P<0.05$) than those offered the low level (37.9 kg/d). Cows consuming the high NFC diet also had lower ($P<0.05$) milk fat (3.25%) and milk urea nitrogen (MUN; 13.68 mg/dl), and higher ($P<0.05$) milk protein (2.58%) and milk lactose (4.81%) concentrations than cows offered the low NFC level (3.46% milk fat, 17.47 mg/dl MUN, 2.51% milk protein, and 4.74% milk lactose). The NFC source did not influence DM intake or milk production ($P<0.05$). Milk lactose (4.79%) and MUN (16.0 mg/dl) concentrations were higher ($P<0.05$) for cows offered sugar as a portion of the NFC compared with those not offered sugar (4.76% milk lactose and 15.13 mg/dl MUN). Results suggest that cows fed sugar may utilize diet nitrogen less efficiently than those not fed sugar.

Key Words: Grass, Non-structural carbohydrates

816 Incorporating risk in dairy cattle nutrition . T.P. Tylutki* and D.G. Fox, *Cornell University, Ithaca NY USA.*

Data from extensive feed sampling and chemical analyses collected over a two-year period on a 600 cow dairy farm were used to evaluate the effect of variation in individual feed chemical components on milk production and income over feed costs. The composition variances (and correlations among feed components) were used in a modified version of the Cornell Net Carbohydrate and Protein System (mCNCPS). The mCNCPS was used with @Risk version 4.0 to simulate milk production variance using Monte Carlo sampling techniques. The diet had IOFC of $10.31 as formulated. The example diet was formulated using the observed feed chemical composition means (assumes perfect information) for 45.4 kg milk valued at $14 per 45.4 kg and simulated over 50,000 iterations (run 1). A second simulation was made locking silage DM, and a third simulation was made where locking silage chemical composition (run 3). Results from run one indicate that hay crop dry matter and lignin content are highly correlated with energy and protein allowable milk. Five percent of the eNDF distribution was below 22%, the breakpoint where the CNCPS begins depressing fiber digestion. Standard deviations were high for energy balance (SD of 1.78 Mcal ME), ME allowable milk (SD of 1.62 kg), and MP allowable milk (SD of 2.16 kg), while mean income over feed cost (IOFC) was $10.19. Run two (DM locked) increased IOFC to $10.22, decreased the variation in ME balance (SD of 1.44 Mcal), ME milk (SD of 1.31 kg), and MP milk (SD of 1.66 kg), yet 5% of the simulations remained below 22% eNDF. Controlling forage DM and composition (run 3) further decreased variation in ME balance (SD of 0.84 Mcal ME), ME milk (SD of 0.76 kg), and MP milk (SD of 1.02 kg) while increasing mean IOFC to $10.28 and all were above 22% eNDF. Comparing this to run 1 suggests that failure to analyze feeds results in $4,380 foregone annual income per 100 cows of which $1,095 is related to DM analysis (difference in IOFC between runs 1 and 2); $2,190 is related to silage analysis (difference in IOFC between runs 2 and 3); and $1,095 is related to concentrates varying (difference in IOFC between run 3 and base). This study suggests that producers can improve IOFC by controlling feedstuff variation via increased forage analysis.

Key Words: Risk, Models, Monte Carlo

817 Effectiveness of strategic ration balancing on efficiency of milk protein production and enviornmental impact. J. H. Harrison*[1], L. Johnson[1], D. Davidson[1], J. Werkhoven[2], A. Werkhoven[2], S. Werkhoven[2], M. Vazquez-Anon[3], G. Winter[3], N. Barney[4], and W. Chalupa[5], [1]*Washington State University,* [2]*Werkhoven Dairy, Monroe, WA,* [3]*Novus Int., St. Louis,* [4]*LignoTech USA, Prairie Village, KS,* [5]*University of Pennsylvania, Kennett Square.*

The standard herd diet for a commercial herd producing 13,600 kg milk annually was reformulated with the use of CPM Dairy model. The primary goal was to reduce CP in the diet and therefore reduce nitrogen imported to the farm. Ration CP was effectively reduced by ∼ 0.8% CP (17.8% CP vs 17.0% CP) with inclusion of Alimet® (Novus International, St. Louis, MO), lysine-HCL, and a commercially available bypass protein source (SoyPass®- LignoTech USA, Prairie Village, KS). Respective diets were fed in a 4-1/2 month switch back design trial with two periods. Cows were fed as groups of ∼90 cows each and were paired for parity and milk production prior to initiation of the study. Cows were milked 4x/day and were provided Posilac®. Diet reformulation was successful in reducing nitrogen imported by 7.5%, increasing milk yield, increased milk yield, increased milk protein yield, reducing MUN, and improving efficiency of milk protein yield. This study illustrates the benefits of reducing dietary CP and improving efficiency of milk protein production. Detailed data are summarized below.

Item	Control	Treated	SE	P≤
DMI, kg	25.77	25.10	—-	—-
CP Intake, kg	4.59	4.25	—-	—-
Milk, kg	45.41	46.32	0.24	.007
3.5% FCM,kg	43.62	43.92	0.21	.32
Milk Fat, kg	1.48	1.47	0.008	.63
Milk Protein, kg	1.31	1.34	0.007	.0004
MUN, mg/dl	17.5	14.5	—-	—-
Ratio Mik True Protein: Intake Protein Ratio	.285	.316	—-	—-

818 Balancing diets for cows grazing pasture post-peak lactation using forage mixed rations. A.V. Chaves*[1,2], S.L. Woodward[3], G.C. Waghorn[1], I.M. Brookes[2], C. Holmes[2], and W. McNabb[1], [1]*AgResearch,* [2]*Massey University,* [3]*Dexcel, Ltd.*

New Zealand dairy cows are grazed on ryegrass (*Lolium perenne*) dominant pasture (P) as a sole diet but dry summers limit P availability so supplementation is needed to maintain productivity. The supplements evaluated here were either maize silage (M) or sulla (*Hedysarum coronarium*) silage (S), which is a low fibre legume containing condensed tannin, fed with pasture or in combination as a forage mixed ration (FMR) over 4 week period. Sixty Friesian cows (10 rumen fistulated); 483 kg live weight (LW); 14.3 kg milk/day; 156 days in milk were allocated to six treatments (%DM basis): normal pasture (P); excess pasture (EP); 60P, 40M (PM); 60P, 40S (PS); 60P, 25M, 15S (PMS); 60P, 25S, 15M (PSM). Normal P allowance (25 kg DM/cow/day) was available for all cows except EP which had 50 kg DM/day. Silage was available to cows during grazing. P, M and S had 17.6%, 6.9% and 17.8% CP; 47%, 38% and 43% NDF, respectively. The normal pasture allowance (P) resulted in an unacceptable LW loss which was overcome by a high allowance (EP) or silage supplementation. Although the EP treatment resulted in highest milk yield, high allowances resulted in higher pasture residuals after grazing and cows lost more weight than those given 6 kg silage DM in PMS, PM and PS treatments. Milk production was similar for cows given all silage supplements, but the PMS prevented weight loss and resulted in highest milk yields. Choice of supplements have resulted from *in sacco* evaluations and will be used to develop balanced diets based on pasture at different times of the year.

	P	EP	PMS	PSM	PM	PS	SEM
Milk, kg/d	13.15^{c}	17.18^{a}	14.28^{b}	13.71^{bc}	13.70^{bc}	13.68^{bc}	0.57
Pasture DMI, kg/d	10.38^{b}	15.71^{a}	8.75^{c}	8.96^{bc}	8.82^{bc}	8.72^{c}	0.7 7
Silage DMI, kg/d			5.78^{a}	5.38^{b}	5.48^{ab}	5.16^{b}	0.24
Total DMI, kg/d	10.38^{c}	15.71^{a}	14.54^{ab}	14.34^{ab}	14.30^{ab}	13.89^{b}	0.90
Change in LW, kg	-12.4^{a}	-3.8^{bc}	$+1.0^{d}$	-4.5^{b}	-0.8^{cd}	-1.4^{bcd}	3.96
FE, kg Milk/ kg DMI	1.27^{a}	1.09^{b}	0.98^{bc}	0.96^{c}	0.96^{c}	0.98^{bc}	0.08

^{a,b,c,d}Least square means with different superscripts differ P<0.05. FE = feed efficiency

Key Words: cow, pasture, silage

819 Effects of simultaneous evaluation of cooling strategies on production responses and intake behavior during heat challenge in dairy cattle. K. M. Spurlin*, D. E. Spiers, M. Ellersieck, and J. N. Spain, *University of Missouri - Columbia*.

Six fistulated, lactating cows were used to compare production and intake behavior when exposed to 4 cooling treatments including 24 h (24H), 12 h nighttime (12N; fans on between 1900 - 0700), 12 h daytime (12D; fans on between 0700 - 1900), and no fan cooling (NO). Treatments were administered during consecutive 14 d periods arranged as a 4×4 Latin Square. Periods were comprised of a 6 d thermoneutral (TN; constant 20C) period, 3 d step-up, and a 5 d heat challenge (HC). During HC, maximum ambient temperature was held at 33C from 1400 - 1800 and lowered to 23C from 0200 - 0600. Feeding occurred at 0600, 1400, and 2200 h daily with refusals and water consumption measured before each feeding to monitor intake patterns. Milk yield was recorded daily. Rumen temperatures were measured continuously via telemetric transmitters located in the ventral rumen. Cooling treatment effects were not different, and reflected the adequate nighttime cooling independent of treatment. Effects of day were significant (P<0.05) for daily yield and intake with milk yield increasing during TN and then declining during HC. Dry matter intake followed a similar pattern, except during HC when feed intake was reduced between 1400 and 2200. Lower feed intake during this time was partially offset by increased intake between 2200 and 0600 (P<0.05). Total water intake increased throughout TN until day 11 of HC, followed by a reduction due primarily to reduce water intake between 1400 and 2200 on the final days of HC. Both DMI and total water consumption were highest between 1400 and 2200, validating the relationship between drinking and feeding behavior. Milk yield peaked on day 10, the first day of HC, while DMI had significantly declined. Rumen temperatures indicated water intake bouts. The difference between maximum and minimum hourly rumen temperatures peaked during times of scheduled human-cow interactions such as milking and feeding, indicating the cows were stimulated to drink upon standing. The heat challenge imposed was not sufficient to simultaneously evaluate the effects of cooling method on productive and intake responses, yet behavioral responses were observed. Rumen temperature differences indicate that management scheme rumen microenvironment.

Key Words: heat stress, feeding behavior, dairy cows

820 Methane and manure production in cattle with different net feed intakes. E. Okine*[1], J.A. Basarab[2], V. Baron[2], and M.A. Price[1], [1]*AFNS, University of Alberta, Edmonton, AB T6G 2P5,* [2]*Western Forage Beef Group, Lacombe Res. Centre, 6000 C & E Trail, Lacombe, AB T4L 1W1.*

Our hypothesis was that methane emissions and manure production would differ among feeder steers with varying net feed intakes (NFI). One hundred and thirty-three spring born steer calves (331 kg; SD=40 kg) from the M1, M2, M3, M4 and TX BeefBooster strains, were adjusted to a high-barley diet and monitored for individual animal DMI. Steers from each genetic strain were selected at random on day 1, 71, 99, 127, 155 and 183 and harvested at the Lacombe Research Centre abattoir. Retained energy and heat production were determined from individual animal gain, intake and body compositional data. Based on NFI calculations 43, 47 and 43 steers were classified as High-NFI (> 0.05 SD above the mean); Medium#NFI (0.05 SD above and below the mean) and Low-NFI (< 0.5 SD below the mean), respectively. Methane production was calculated from the steers requirement for ME, in vivo diet DE and DMI above that required for maintenance. There was no difference in methane production as percent of GE (5.59 1.16; P>0.05) among NFI groups. However, daily methane emissions (g d^{-1} and g kg $gain^{-1}$) for Low-NFI steers were 9.0 and 12.6%) lower (P<0.02) than for High-NFI steers, with no difference between High- and Medium-NFI steers. Yearly manure, N, P and K production were all low, medium and high (P <0.0001) for Low, Medium and High-NFI steers, respectively. Low-NFI steers with above average ADG ($\geq$1.48 kg d^{-1}) produced 53 compared to 67.9 kg kg $gain^{-1}$ methane (P<0.001) than the High-NFI steers with below average ADG. We conclude that selection for Low-NFI in beef cattle is in theory accompanied by a significant reduction in methane, manure and N, P, K, output due to reduction in daily feed intake and more efficient use of feed without any compromise in growth performance.

Key Words: Key words: Beef cattle, Net feed intake, Manure, Methane

821 The interaction between plane of nutrition and success of estrus synchronization using two methods. E. Charmley*[1], J. Wichtel[2], G. Richardson[2], and R. Lofstedt[2], [1]*AAFC, Crops and Livestock Research Centre,* [2]*Atlantic Veterinary College*.

Plane of energy nutrition has a major impact on reproductive efficiency. In a study with 57 winter-calving beef cows, grass/legume silage was fed at one of three levels of intake; 1.5, 1.7 and 2.0% of body weight (BW). Equal numbers of cows on each plane of nutrition were assigned, according to calving date and parity, to one of two estrus synchronization methods: Ovsynch and CIDR. The Ovsynch method involved an injection of GnRH followed 7 d later by an injection of prostaglandin and a second GnRH injection 48 h after that. Cows were bred 16 h following the second GnRH injection. The CIDR method involved the insertion of an intravaginal device containing 1.9 g progesterone for 7 d. An intramuscular injection of 1 mg estradiol benzoate and 100 mg progesterone was given at the time of device insertion. Twenty-four h after CIDR withdrawal, cows recieved an additional injection of 1 mg estradiol benzoate and were bred 28 h after this injection. Although calculated ME intakes were 86, 97 and 115 MJ d^{-1} for the low, medium and high intakes, respectively, there was no effect on cow BW change, body condition score, rump fat or back fat. However, there was a direct linear response to plane of nutrition in calf BW gain (P=0.02) and calf weights at turn-out to pasture (P=0.04). This was attributed to a quadratic increase in milk fat % (P=0.04) and a similar trend in milk protein % (P=0.09) as plane of nutrition increased. Overall first service pregnancy rates were acceptable being 61 and 83% for the Ovsynch and CIDR methods respectively (P=0.13). However there was a marked diet by synchronization method interaction. First service pregnancy rates for cows on the Ovsynch method were 29, 57 and 89 % for low, medium and high planes of nutrition, respectively (P=0.04). Corresponding pregnancy rates for cows sunchronized with CIDR's were 80, 80 and 89% (P=0.83). It is concluded that the success of CIDR synchronization method may be less sensitive to plane of nutrition than more traditional methods of estrus synchronization.

Key Words: Estrus synchronization, Plane of nutrition, Beef cow