M151 Implementation of the LOCAL algorithm with near-infrared spectroscopy in forage resources for grazing systems of dairy cattle in Colombia. C. Ariza-Nieto*[1], B. Mojica[2], D. Parra[1], O. L. Mayorga[1], and G. Afanador[2], [1]*CORPOICA, Bogota, Colombia,* [2]*Universidad Nacional de Colombia, Bogota, Colombia.*

Near-infrared reflectance spectroscopy (NIRS) analysis is based on the development of calibration equations that relate constituents and the infrared information spectrum. This study compares 2 chemometric tools for developing NIRS prediction models: the GLOBAL modified partial least squares and the recently calibration strategy known as LOCAL. The LOCAL procedure is designed to select, from a large database, samples with spectra resembling the sample being analyzed. A multispecies data sets of 2,448 forage samples (1,872 grass forages, 315 legume forages, and 261 forage trees) were used for the prediction of crude protein (CP), crude ash (CA), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL). The samples were randomly divided into a calibration set (n = 2204) and a validation set (n = 244). Spectra were collected using a Foss NIRSystems model 6500 scanning VIS/NIR spectrometer, each spectrum was collected in the range of 1108–2492 nm every 2 nm, the spectra were normalized by standard normal variate and detrend, transformation followed by a first order derivation (1,4,4,1; first derivate, 4nm gap, 4 points of first smoothing, 1 point of second smoothing). Calibration performance for each model was assessed by standard error of calibration, coefficient of determination of calibration, standard error of cross-validation, coefficient of determination of cross-validation, and residual predictive deviation. LOCAL calibration reduced the bias and produced a significant decrease in the standard prediction error compared with the GLOBAL calibration; CP (0.86 vs 0.99), CA (0.68 vs 0.79), NDF (1.29 vs 2.71), ADF (1.78 vs 2.02), and ADL (0.87 vs 1.23). The coefficient of determination values were improved using the LOCAL strategy exceeding 0.90 for all chemical constituents. The use of LOCAL algorithm accurately predict the composition of forages and could offer a practical way to develop a robust equation taking into account the biodiversity of Colombian forage resources.

Key Words: forage resourses, global calibration, local calibration

M152 Characterization of forage resources of Colombian highlands grazing systems using LOCAL algorithm with near-infrared spectroscopy. C. Ariza-Nieto*[1], B. Mojica[2], O. L. Mayorga[1], A. Sierra[1], E. Mancipe[1], J. Vargas[1], and G. Afanador[2], [1]*CORPOICA, Bogota, Colombia,* [2]*Universidad Nacional de Colombia, Bogota, Colombia.*

Fiber fractions and protein content are important chemical characteristics of forage resources because of their close relationship with factors affecting the performance of dairy cows. Advances in methodologies for evaluating those characteristics and the use of indirect methods such as the near-infrared spectroscopy (NIRS) promote the chemical characterization of forage as a fundamental tool to assess the efficiency of milk production under specific conditions in production. In this study, crude protein (CP), crude ash (CA), neutral detergent fiber (NDF), acid detergent fiber (ADF), and acid detergent lignin (ADL) were estimated using the NIRS LOCAL algorithm in the spectrum of 1100–2500 nm every 2 nm using the FOSS NIRSystems 6500. Two hundred seventy forage resources were contextualized in terms of their topographical location (wavy, slope and flat), pasture harvest season or cut grass (rainfall, drought, rainfall-drought transition, drought–rain transition), the fertilization (yes or no) and altitude. The topography affected the CP level of the forage resources, being this lower in the slope (12.8%, $P < 0.05$). Harvest season affected NDF and ADF ($P < 0.05$). The NDF level was higher in the rainfall-drought transition compared with the drought-rain transition (57.5 vs 59.6%, $P < 0.05$). The ADF level was higher in the drought-rain transition compared with drought (29 vs 27.7%, $P < 0.05$). Fertilization affected levels of CP, CA, NDF, and ADL ($P < 0.05$); CP was higher when fertilization was applied to the grasslands (14.5 vs 11.4%, $P < 0.05$), while NDF was lower when fertilization was applied (59.2 vs 57.7%, $P < 0.05$). The CA level was also higher when fertilization was applied (10.6 vs 9.5%, $P < 0.05$), while ADL level was lower when fertilizer was applied (30.7 vs 29.4%, $P < 0.05$). Concentration of CP was affected by the altitude where the value was higher for samples above 2500 m above sea level. (14.2%, $P < 0.001$). At this level, the concentrations of NDF (55.9%) and ADL (5.2%) were lower ($P < 0.001$). It was concluded that the most critical variables in the determination of forages quality in dairy feeding systems are overcome taken advantage of the new technologies as NIRS.

Key Words: tropical forage, nutritional value, fiber content

M153 Effects of a chemical additive on aerobic stability and fungal microbiome of corn silage. E. Benjamim da Silva*[1,2], R. M. Savage[1], S. A. Polukis[1], M. L. Smith[1], R. N. Mester[1], A. M. Gray[1], and L. Kung Jr.[1], [1]*University of Delaware, Newark, DE,* [2]*CAPES Foundation, Brasília, DF, Brazil.*

The objective of this experiment was to determine the effectiveness of Safesil (SF; 20% sodium benzoate, 10% potassium sorbate, 5% sodium nitrite) from Salinity, Sweden on improving aerobic stability of corn silage, and to evaluate its effects on fungi population by analysis of the internal transcribed space 1 (ITS1). Whole-plant corn was harvested at 39% DM, chopped, and untreated (CTRL) or treated with SF (2 L/t). Four replicated silos (7.5 L) were packed (224 kg of DM/m^3) and ensiled for 85 d. Portions of CTRL and SF silages, and CTRL silage treated after ensiling with SF were used to make a total mixed ration (TMR) containing 40% corn silage, 20% alfalfa silage, and 40% grain mix. Samples were analyzed for microbial populations, fermentation profile, and aerobic stability (h before a 2°C increase above baseline after air exposure at 22°C). Three replicates of each fresh forage, and CTRL and SF silages were analyzed for fungal composition. DNA extraction, amplification of ITS1, library preparation, and sequencing, by Illumina MiSeq (San Diego, CA) platform, were performed by Research and Testing Laboratory (Lubbock, TX). Data were analyzed using JMP 12.0 and QIIME 1.9.1. SF had fewer yeasts ($P < 0.01$), lower pH ($P < 0.01$), and lower concentration of ethanol ($P < 0.01$) compared with CTRL. SF (241 h), TMR with SF silage (71 h), and TMR containing silage treated with SF after ensiling (82 h) had improved ($P < 0.01$) aerobic stability compared with CTRL silage (37 h) and CTRL TMR (41 h). Chao1 index indicated that fungal diversity was higher ($P < 0.05$) in fresh forage and decreased after ensiling. The relative abundance of genus *Candida* was lower ($P < 0.01$) in SF (6.3%) than CTRL (46.2%). The chemical additive greatly improved the aerobic stability of silage. Additionally, it has the potential to be used as a TMR stabilizer, if applied after ensiling. The improvement on aerobic stability by the chemical additive might be due to its capacity to reduce total numbers of yeasts,

and to decrease specific populations of yeasts associated with lactate assimilation, such as *Candida*.

Key Words: chemical additive, silage, microbiome

M154 A sensory additive increased milk response to concentrate supplementation in dairy cows grazing kikuyu pastures. L. M. Gómez[1], P. Aguirre[1], F. Bargo*[2,3], G. Tedó[2], and I. Ipharraguerre[4,2], [1]*Solla, Medellín, Colombia,* [2]*Lucta SA, Barcelona, Spain,* [3]*Universidad Buenos Aires, Buenos Aires, Argentina,* [4]*University of Kiel, Kiel, Germany.*

Forty-five Holstein dairy cows (147 d-in-milk and 544 kg BW on average) were assigned to a 3 × 3 Latin square design replicated 15 times to evaluate the effect of a sensory additive (ProEfficient, PE; Lucta SA, Barcelona, Spain) on milk response to concentrate supplementation on pasture. Cows were blocked by parity in 15 blocks and within blocks randomly assigned to one of 3 treatments: 0 kg/d concentrate (0C); 5 kg/d control concentrate (CC); and 5 kg/d CC with 30 g/d of PE (PEC). Cows grazed a kikuyu (*Pennisetum clandestinum*) pasture for 84 d in 3 28-d periods. Targeted pasture allowance was 35 kg DM/cow. Pasture averaged 24.2% CP, 55.5% NDF, and 60.3% in vitro DM digestibility (IVDMD). Concentrates were fed twice daily at milking. Concentrate (44.3% corn, 11.2% wheat bran, 10.0% corn gluten feed, 8.6% rice meal, 8.4% soybean meal, 8.0% of sunflower meal, 9.5% mineral premix) averaged 18.4% CP, 17.8% NDF, and 85.5% IVDMD. Data were analyzed using a mixed model that included the fixed effects of treatment, block, period, their 2-way interactions, and the random effect of cow within block. On average, supplementation with the starch-based concentrate increased ($P < 0.05$) milk yield at 6.2 kg/d compared with 0C (15.9 vs. 22.1 kg/d, SEM 0.51). However, cows supplemented with PEC produced more ($P < 0.05$) milk than CC cows (22.7 vs. 21.4 kg/d, respectively; SEM 0.51). Milk production response to concentrate supplementation was improved at 15% ($P < 0.05$) by the addition of PE into the concentrate (1.32 kg vs. 1.15 kg milk/kg concentrate for PEC and CC, respectively). Concentrate supplementation reduced ($P < 0.05$) milk fat percentage (3.69 vs. 3.93%, SEM 0.065) and milk urea N (17.0 vs. 19.3 mg/dl, SEM 0.45). Milk fat and protein yield were increased ($P < 0.05$) by concentrate supplementation (0.794 vs. 0.620 kg/d, SEM 0.022 and 0.686 vs. 0.497 kg/d, SEM 0.016; respectively) compared with CC. The milk response triggered by PE might be associated with a reduction in the substitution rate of CC for pasture.

Key Words: sensory additive, milk response to supplementation, grazing dairy cows

M155 Feed laboratory demographics and utilization in the United States. J. Severe* and A. J. Young, *Utah State University, Logan, UT.*

Feed analysis is the basis for buying and selling many feeds of interest. The point of contact between these 2 entities is the laboratory that analyzed the sample. Little research has been conducted specifically to describe feed laboratories in the United States; therefore, the objective of these surveys was to determine US feed laboratory demographics and utilization. In the first survey, laboratory demographic data were compiled from internet and laboratory sources. Based on this information, 114 feed laboratories were identified and selected. About 76% of the laboratories were commercial entities; the rest were state departments of agriculture (17%), universities (5%), and USDA (2%). Interestingly, universities in the Gulf and southeast US sponsored 63% of feed laboratories in that region. Approximately 80% of labs used wet chemistry and 52% used NIR analysis. Mean participation in NFTA certification from 2010 to 2014 was 67%. Commercial laboratories credited in refereed journals increased by 450% from 2004 to 2013; 3 laboratories accounted for 85% of credits. The second survey collected data from members of a trade organization with a response rate of 52% (161 out of 308); 72% indicated that they used a laboratory. Laboratory use by trade sector was beef (47%), equine (46%), retail feeds (60%), dairy (100%), and export (100%). Respondents reported using 45 different feed laboratories; one was used by 22% of respondents. Qualities that determined lab selection from most to least important were certification, reputation, sample turnaround time, and cost. Preference was for NIR (47%) compared with chemical analysis (21%), or no preference (32%). Preference for NIR was primarily due to turnaround time, while preference for wet chemistry was chiefly due to accuracy. Fifty percent of respondents were dissatisfied with feed laboratory performance, 49% reported financial lost due to feed analysis concerns, and 35% indicated harm to business relationships from feed analysis issues. These surveys show that out of 114 labs, 2 or 3 analyze most of the samples. All individuals associated with the dairy and export market use laboratories and NIR is evolving toward becoming the preferred method for analysis.

Key Words: feed laboratories, NIR, survey

M156 Effects of nitrogen fertilization on the nutritive value of oat forages. W. K. Coblentz*[1], M. S. Akins[2], and J. S. Cavadini[3], [1]*US Dairy Forage Research Center, Marshfield, WI,* [2]*Department of Dairy Science, University of Wisconsin-Madison, Madison, WI,* [3]*University of Wisconsin Marshfield Agricultural Research Station, Marshfield, WI.*

Nitrogen fertilization is a routine part of forage management strategies for grasses, but the effects on forage nutritive value have been inconsistent. Our objectives were to evaluate the effects of N fertilization on the nutritive value of fall-grown oat fertilized at planting with 20, 40, 60, 80, or 100 kg N/ha of urea or 2 rates of dairy slurry (42,300 or 84,600 L/ha). Oat forages fertilized with urea or dairy slurry had greater ($P < 0.001$) concentrations of fiber components compared with those harvested from unfertilized check plots (0 kg N/ha), and fiber concentrations increased linearly ($P < 0.001$) with urea fertilization rate. In contrast, concentrations of water-soluble carbohydrates were greatest for unfertilized forages (21.2%), but declined linearly ($P < 0.001$) with urea fertilization, exhibiting a minimum of 13.5% at the 80 kg N/ha application rate. Similarly, non-fiber carbohydrate also declined linearly ($P < 0.001$) from 34.8% for unfertilized plots to a minimum of 24.6% at the 80 kg N/ha urea application rate. Expressed on a percentage of DM basis, fertilization with urea resulted in linear ($P < 0.001$) increases in crude protein (CP), neutral-detergent soluble CP, neutral-detergent insoluble CP, and acid-detergent insoluble CP, but effects on subcomponents of the total CP pool were not observed when concentrations were expressed on a percentage of CP basis ($P > 0.117$). The summative calculation of energy (TDN) was closely related to N fertilization rate during both the 2013 ($Y = -0.038 x + 72.2$; $r^2 = 0.961$) and 2014 ($Y = -0.040 x + 69.2$; $r^2 = 0.771$) production years. Following 30- or 48-h incubations in buffered rumen fluid, in vitro DM disappearance was greater ($P \leq 0.024$) for unfertilized forages compared with those fertilized with either urea or dairy slurry, and DM disappearance declined linearly ($P \leq 0.001$) with urea fertilization rate; however, these responses were not detected ($P \geq 0.109$) for neutral-detergent fiber disappearance. Overall, the forage nutritive value of fall-grown oat declined mildly in response to N fertilization, resulting in losses of approximately 0.4 percentage units of TDN for every 10 kg N/ha applied as urea.

Key Words: N fertilization, nutritive value, oat

M157 Winter supplementation of ground whole flaxseed impacts milk fatty acid composition on organic dairy farms in the northeastern United States. A. N. Hafla[1], K. J. Soder*[1], A. F. Brito[2], R. Kersbergen[3], A. F. Benson[4], H. Darby[5], M. D. Rubano[1], S. L. Dillard[1], J. Kraft[5], and S. F. Reis[2], [1]*USDA-ARS, University Park, PA,* [2]*University of New Hampshire, Durham, NH,* [3]*University of Maine, Orono, ME,* [4]*Cornell University, Cortland, NY,* [5]*University of Vermont, Albans, VT.*

Fourteen organic dairy farms were used to (1) evaluate seasonal variation of bioactive fatty acids in milk; and (2) evaluate supplementation of ground whole flaxseed to maintain levels of bioactive fatty acid concentrations during the non-grazing season. During year round farm visits (twice a month during the grazing season and once monthly during the non-grazing season) from April 2012 until April 2015, milk, feed, and pasture samples were collected, and diet and milk production and composition recorded. During the winters of 2013–14 and 2014–15, 9 farms supplemented ground whole flaxseed at 6% of diet dry matter to half of the cows within each herd (n = 238 cows/treatment). Milk samples were collected and pooled by treatment (flaxseed or control). Data were analyzed using the MIXED procedure of SAS. A month × year interaction ($P < 0.01$) for omega-3 fatty acid concentrations indicated an increase beginning in April of 2014 through the end of the study. Total milk conjugated linoleic acid (CLA) concentrations were seasonal with greatest ($P < 0.01$) concentrations (1.32% of total fatty acids) during the grazing season. Winter flaxseed supplementation did not impact concentrations of milk fat and milk protein, or body condition score. Compared with the control diet, flaxseed decreased total milk saturated fatty acid concentrations ($P < 0.01$) by 3.1 percentage units, increased omega-3 fatty acid concentrations ($P < 0.01$) by 88%, and tended ($P = 0.13$) to increase total CLA concentrations ($P = 0.13$) by 9.0%. While flaxseed supplementation increased milk omega-3 fatty acid concentrations, minimal impacts on saturated fatty acid and total CLA concentrations indicated a greater level of winter supplementation is required to maintain concentration of all beneficial fatty acids comparable to the grazing season.

Key Words: flaxseed, milk fatty acids, grazing

M158 Nutrient composition and management characteristics of California sorghum silage. J. Heguy*[1], J. Dahlberg[2], P. Price[4], J. Martins[3], N. Clark[3], N. Silva-del-Rio[5], and D. Meyer[4], [1]*University of California, Ag & Natural Resources, Modesto, CA,* [2]*University of California, Ag & Natural Resources, Parlier, CA,* [3]*University of California, Ag & Natural Resources, Tulare, CA,* [4]*University of California, Davis, Davis, CA,* [5]*University of California, Veterinary Medicine Teaching & Research Center, Tulare, CA.*

The aim of this study was to obtain information on current sorghum management practices and sorghum silage quality from dairy farms (n = 16) located in California's San Joaquin Valley. Herd size ranged from 320 to 5,500 lactating dairy cows (median = 2,013). Dairy producers answered short agronomic and harvest management surveys. At harvest, during summer and fall of 2016, 10 consecutive truckloads of chopped sorghum were sampled and composited for wet chemistry nutrient analysis (Table 1). Hectares of farmed sorghum ranged from 16.9 to 232.3 ha (median = 76.1); sorghum types were grain (n = 5), brown midrib (n = 10) and unknown (n = 1). Sorghum was stored in piles (n = 12) and bags (n = 4). Dairies with piles built one (n = 7), 2 (n = 3) or 3 (n = 2) sorghum silage piles, while bagged silage was stored in 5 or more bags on all dairies. Half of the dairies stored their sorghum silage on dirt surfaces. Delivery rate of the 10 truckloads of sorghum ranged from 12 to 78 min (median = 40). All dairies utilized custom harvesting services. Quality of sorghum harvested for silage was variable, with lower starch and NFC content and higher ash content than the traditional summer corn crop grown in California.

Key Words: California, sorghum silage, silage management

M159 Effect of type of processor and storage length on corn silage processing score in whole-plant corn silage samples. L. F. Ferraretto*[1], J. P. Goeser[2,3], and K. A. Bryan[4], [1]*University of Florida, Gainesville, FL,* [2]*Rock River Laboratory Inc., Watertown, WI,* [3]*University of Wisconsin-Madison, Madison, WI,* [4]*Chr. Hansen, Milwaukee, WI.*

The objectives of this study were to evaluate the effect of: 1) processor type on fermentation profile, corn silage processing score (CSPS) and physically effective NDF (peNDF) of whole-plant corn silage (WPCS) samples, and 2) storage length on WPCS CSPS. A data set comprised of 3,900 WPCS samples was obtained from Rock River Labs (Watertown, WI). All samples were collected from 2013 to 2016 by the Chr. Hansen team under specific protocols to label samples as shredlage (SHRD) only if confirmed by farmers and/or custom harvesters. A total of 309 and 3591 samples were labeled as SHRD and non-shredlage (CONV), respectively. Month of submittal was assumed to be associated with time in storage, with Sep. and Aug. being 1 and 12 mo of storage, respectively. Samples had been previously analyzed for CSPS, peNDF and ruminal in vitro NDF digestibility at 30 h (ivNDFD; using NIRS). In addition, 2394 samples (272 SHRD and 2394 CONV) had previously been analyzed via wet chemistry for fermentation profile. Loss of DM during fermentation was calculated with a predictive equation (Goeser et al., 2015; PAS 31:137–145). Data were analyzed using Proc Glimmix in SAS with either type of processor (SHRD vs. CONV) or month of sample submittal as fixed effect. Statistical significance and trends were declared at $P < 0.05$ and $P > 0.05$ to $P < 0.10$, respectively. Measurements of pH were lower ($P = 0.01$; 3.90 vs. 3.97) for SHRD than CONV, which was related to higher ($P = 0.001$; 4.89% vs. 4.34% of DM) lactic acid concentrations. Concentrations of acetate, propionate, butyrate and ethanol did not differ ($P > 0.10$) and averaged 2.27%, 0.35%, 0.36%

Table 1 (abstract M158). Nutrient composition of chopped sorghum sampled at harvest from dairy farms (n = 16) in California's San Joaquin Valley

		% of DM						NDFD 30,
	DM	CP	ADF	NDF	Starch	NFC	Ash	% of NDF
Mean	28.7	9.5	34.6	49.7	10.9	26.3	12.2	48.6
Median	28.4	9.7	34.9	50.4	9.6	27.4	11.8	50.5
Minimum	23.2	5.7	30.4	44.9	1.9	14.4	9.2	35.1
Maximum	34.6	11.7	40.2	55.3	22.5	35.6	21.5	60.3
SD	3.3	1.8	3.1	3.8	6.7	6.0	2.9	7.8

and 0.57%, respectively. Loss of DM was minor but lower ($P = 0.05$; 2.42% vs. 2.73%) for SHRD. A 4.6%-units greater CSPS was observed ($P = 0.001$; 68.1% vs. 63.53% starch passing through 4.75 mm sieve) for SHRD than for CONV samples. In contrast, peNDF and ivNDFD were ($P = 0.001$) 1.8%- and 1.6%-units greater for CONV. A gradual increase in CSPS from Sep to Dec was observed ($P = 0.001$), followed by a decreased in Jan/Feb and a subsequent increase from Mar to Aug. Our results suggest that harvesting WPCS as SHRD improve kernel breakage while maintaining adequate fermentation patterns.

Key Words: corn silage processing score, shredlage, fermentation

M160 Evaluation of yield and quality of photoperiod-sensitive sorghums in central Wisconsin. E. Remick*[1], M. Akins[1], A. Grisham[1], H. Su[2], W. Coblentz[3], and R. Ogden[3], [1]*Department of Dairy Science, University of Wisconsin, Madison, WI,* [2]*College of Animal Science and Technology, China Agricultural University, Beijing, China,* [3]*US Dairy Forage Research Center, Marshfield, WI.*

A 2-year study (2015, 2016) was conducted at 2 sites (Marshfield, Hancock) in central Wisconsin to assess yield and quality of photoperiod sensitive (PS) and non-PS sorghums in relation to corn planted on 2 dates and harvested once or twice. At each site, treatments were arranged in a split-split plot in a randomized complete block with 4 replications. Main plots of planting date (early or mid-June) were randomized within block. Subplots of harvest strategy (harvested once or twice) were randomized within planting date. Within harvest strategy, 8 forages were assigned (corn, PS sorghum, PS sorghum-sudangrass, sorghum, brown midrib (BMR) sorghum, sorghum-sudangrass, BMR sorghum-sudangrass, or PS-BMR sudangrass). Multi-harvests occurred in mid-summer and fall, and single harvest was based on maturity or after a frost. Data were analyzed using the Mixed model of SAS. Single harvest plots had greater yields than multi-harvest (18,961 vs 9,970 kg DM/ha; $P < 0.01$), a site by harvest interaction ($P < 0.01$) suggested 2 harvests were more similar to 1 harvest at Marshfield than Hancock. Yields were greater at Hancock than at Marshfield (16,562 vs 12,370 kg DM/ha; $P < 0.01$) and were greater in 2016 than 2015 (18,262 vs 10,669 kg DM/ha; $P < 0.01$). The early June planting had greater yields than mid-June (15,320 vs 13,612 kg DM/ha; $P = 0.02$). There was a harvest x variety (Table 1; $P < 0.01$) interaction; single harvest PS varieties and non-PS sorghum-sudangrass yielded more than BMR varieties, corn and forage sorghum were intermediate. Sorghum-sudangrass and sudangrass had more similar yields using either 1 or 2 harvests than other varieties. Overall, sorghum can provide high yields of moderate quality forage.

Table 1 (abstract M160). DM yields (kg/ha) for sorghums and corn using single or multiple harvests at Hancock and Marshfield in 2015 and 2016

	Harvest	
Forage[1]	Single	Multi
Corn	17,551	5,159
PS forage sorghum	23,606	9,024
PS sorghum-sudan	25,218	13,850
Forage sorghum	18,054	10,677
Sorghum-sudan	21,067	14,412
BMR forage sorghum	16,372	8,128
BMR sorghum-sudan	14,964	9,206
PS BMR sudangrass	14,857	9,307
SEM	1,038	
Variety × harvest (*P*-value)	<0.01	

[1]PS = photoperiod sensitive; BMR = brown midrib.

Key Words: sorghum forage, harvest strategy

M161 Comparison of two in situ reference methods to estimate indigestible NDF by near infrared reflectance spectroscopy. G. J. Zhang*[1], Y. H. Yan[2], M.H. Hall[3], D. J. Undersander[4], and D. K. Combs[4], [1]*Ningxia University, Yinchuan, Ningxia Hui, China,* [2]*Sichuan Agriculture University, Chengdu, Sichuan, China,* [3]*Pennsylvania State University, State College, PA,* [4]*University of Wisconsin, Madison, WI.*

Undigested forage NDF residues (uNDF) from long-term ruminal in situ incubations are used to estimate indigestible fiber (iNDF). Estimation of iNDF is important in forage evaluation because it defines the potentially digestible pool of NDF. Near-infrared reflectance spectroscopy (NIRS) can be calibrated to in situ reference sets to rapidly predict uNDF. Our objective was to compare uNDF estimates after 240 h of incubation when 2 types of bags were used in the in situ reference method. The bags compared were 4 cm × 5 cm Ankom F57 bags (25-µm pore size), and 5 cm × 10 cm Ankom in situ bags (50-µm pore size). Alfalfa samples taken from Pennsylvania and Wisconsin (n = 144) of different varieties and harvest intervals were used. Forages were dried 48h at 60°C and ground through a 2mm screen in Wiley mill. One-half or 2 g samples, respectively, were weighed into the small and large bags in triplicate. Mass to surface area was 0.05 and 0.02 g/cm^2 for the small and large bags, respectively. The uNDF content after 240 h incubation were evaluated by 2 bag types in 3 rumen-cannulated Holstein cows. Each dried and ground forage was also scanned to determine the visible–near-infrared-reflectance spectra using with a FOSS NIRSystems 6500 spectrophotometer. Prediction equations were developed for each bag type using partial least square regressions. The estimated uNDF fraction from small and large bags were 13.75% and 9.97%, respectively (SED = 0.39, $P < 0.001$). The coefficient of determination for calibration (RSQ), cross-validation (1 − VR), calibration standard deviation (SEC), and interactive authentication standard deviation (SECV) was 0.94, 0.92, 0.85 and 0.98 for uNDF values determined with the small bag and 0.88, 0.85, 1.12 and 1.27 for uNDF values determined with the large bag calibration sets, respectively. Results indicate that uNDF vary and NIRS can be used to quickly and quantitatively estimate iNDF content in alfalfa. Bag type influences 240-h NDF residues. NIRS predictions of uNDF from the small bag calibration had higher RSQ and lower SEC and SECV than the large bag calibrations.

Key Words: NIRS, undigested NDF, alfalfa digestibility

M162 Simulating the effects of forage harvesting strategies on dairy farm profitability and agro-environmental performance in Canada. V. Ouellet*[1], G. Belanger[2], S. Binggeli[1], D. Pellerin[1], G. Tremblay[2], G. Jego[2], M. Chantigny[2], V. Baron[3], and E. Charbonneau[1], [1]*Universite Laval, Quebec City, QC, Canada,* [2]*Agriculture and Agri-Food Canada, Quebec City, QC, Canada,* [3]*Agriculture and Agri-Food Canada, Lacombe, AB, Canada.*

Maintaining cow productivity, while decreasing the proportion of concentrates may require cutting forages at an early stage of development with reduction in yield and persistence. Our objective was to use the whole-farm model N-CyCLES to assess the effect of 2 forage harvesting strategies on dairy farm profits, N and P balance, and greenhouse gas emissions, while optimizing the management practices required to achieve maximum profits. Three model Canadian dairy farms under contrasting climate (Maritimes, Central Canada, and Prairies) were built in the model. Adaptations made to the model included modification to crop rotations, adjustment in the optimization constraints, evaluation of crop production cost, evaluation of forage nutritive value and yield, and update in fertilization requirements. Two harvesting strategies of divergent intensity of alfalfa-based forages were compared within each

Table 1 (abstract M162). Effects of two different harvesting strategies on dairy farm net income, greenhouse gas emission, P and N balance

	Maritimes[1]		Central Canada[2]		Prairies[3]	
	HS1	HS2	HS1	HS2	HS1	HS2
Profit ($/100 kg FPCM[4])						
Net income	10.3	12.2	20.4	22.2	22.1	24.0
Crop income	3.5	4.7	10.4	12.8	5.0	6.5
Greenhouse gas emission						
Total kg CO_2eq. FPCM (kg/yr)	1.4	1.4	1.3	1.4	1.3	1.3
Mineral balance (g/kg FPCM)						
N	13.6	12.2	14.6	14.3	14.5	14.3
P	1.7	1.6	0.5	−0.1	1.0	1.3

[1]63 cows; 513 584 kg/yr.

[2]71 cows; 613 841 kg/yr.

[3]144 cows; 1 212 875 kg/yr.

[4]Fat- and protein-corrected milk.

region: HS1: frequent harvests at an early development stage producing highly digestible forages and HS2: less frequent harvests at the recommended development stage producing higher forage dry matter yields of medium digestibility. Highest dairy farm profits were achieved under HS2 for the 3 model farms. This is explained by the greater income arising from higher forage yields produced under HS2. Moreover, HS2 achieved better performance for most agro-environmental parameters when compared with HS1. These results suggested that harvesting forages at the usual maturity stage is more profitable and, allows for better agro-environmental performance than harvesting more frequently for higher nutritive value.

Key Words: harvesting strategy, whole-farm model, profitability

M163 Fermentation profile and identification of lactic acid bacteria and yeasts of rehydrated corn kernel silage. B. F. Carvalho, T. Fernandes*, M. N. Pereira, R. F. Schwan, and C. L. S. Ávila, *Universidade Federal de Lavras, Lavras, Minas Gerais, Brazil.*

Storing grain by rehydration and ensiling has the potential to improve the digestibility. Characterizing the microbial communities may help understand silage fermentation, intervene in the fermentation process, and improve the quality. We evaluated the chemical composition, in vitro DM digestibility (ivDMD), lactic acid bacteria (LAB), spore forming aerobic bacteria, and yeasts populations in rehydrated corn kernel silage. The DM concentration of the ground corn was measured, and water was added to increase the moisture to 30%. Approximately 4 kg of rehydrated kernel were ensiled in experimental silos. Four replicates for each fermentation time at 5, 15, 30, 60, 90, 150, 210, and 280 d were prepared. The microbial communities were counted and BAL and yeasts were identified. According to the cluster analysis of matrix-assisted laser desorption/ionization time-of-flight (MALDI-TOF) mass spectra, representative microbial strains were identified by sequence analysis of the full-length 16S rRNA gene for bacteria and the internal transcribed spacer (ITS) region for yeast. The highest DM loss was 7.6% after 280 d. The low concentration of water-soluble carbohydrates (20 g kg^{-1} of DM) was not limiting for fermentation, however in pH and acid production occurred slowly. Storage of the rehydrated corn kernel silage increased ivDMD up to d 280. The bacteria population reached maximum growth after 15 d. A total of 178 bacteria were isolates. Fourteen different LAB species, 3 species of *Enterobacteriaceae*, and one *Staphylococcus* species were identified from the MRS medium. Homofermentative species dominated the fermentation. A total of 103 isolates were identified as yeasts. The species *Hyphopichia burtonii*, *Wickerhamomyces anomalus*, *Issatchenkia orientalis*, and *Meyerozyma guilliermondii* were identified from Dichloran Rose Bengal Chloramphenicol Agar. There was no significant difference in the yeast population. The spore-forming aerobic bacteria count reached a peak at d 30 of fermentation. Molds were detected until the d 15. This silage was dominated by LAB but showed slow decreases in pH values.

Key Words: silage fermentation, molds, spore-forming aerobic bacteria

M164 Simulating the effect of corn silage substitution by sweet pearl millet or sweet sorghum silages on dairy farm profitability and agro-environmental performance in Canada. J. Velarde-Guillén*[1], D. Pellerin[1], L. Guerra-Alarcon[1], A. Vanasse[1], M. Chantigny[2], V. Baron[3], and É Charbonneau[1], [1]*Université Laval, Québec, QC, Canada,* [2]*Agriculture and Agri-Food Canada, Québec, QC, Canada,* [3]*Agriculture and Agri-Food Canada, Lacombe, AB, Canada.*

Corn silage (CS) is widely used on dairy farms because of its high yields and energy content. Sweet pearl millet (SPM) and sweet sorghum (SS) are forages that can produce yields similar to CS, but with lower N needs. The aim of this study was to evaluate the economic and environmental differences of CS substitution by SPM or SS through simulations with the whole-farm model N-CyCLES. Three virtual farms were built in the model for contrasted climate and agricultural regions (Maritimes: 63 cows and 513 584 kg/yr, Québec/Ontario: 71 cows and 613 841 kg/yr, and Prairies: 144 cows and 1 212 875 kg/yr). The model was adjusted for crop growth and rotations, fertilization needs, and constraints specific to each virtual farm type. The SPM was evaluated as a replacement for CS in the 3 climate regions, whereas SS was tested for Québec/Ontario, the only region with the appropriate climate for this plant. Results show that replacing CS for SPM and SS caused a slight decrease in net income per kg of FPCM (−7% in average). Environmentally, replacing CS for SPS and SS reduced greenhouse gas emissions per kg of FPCM (−4% on average), increased P balances (+93% on average), but lowered N balances for 2 out of 3 regions (−9% on average). These results suggest that, although CS is a good option, its substitution by SPM or SS is a viable alternative for Canadian dairy production.

Key Words: corn silage, sweet pearl millet silage, sweet sorghum silage

Table 1 (abstract M164). Farm economic and environmental impacts of forage type

	Maritimes		Quebec/Ontario			Prairies	
	CS	SPM	CS	SPM	SS	CS	SPM
Dairy farm profit ($/kg FPCM[1])							
Net income	0.10	0.08	0.21	0.20	0.20	0.22	0.22
Crop income	0.03	0.04	0.09	0.06	0.06	0.01	0.01
Greenhouse gas emission (kg CO_2 eq./kg FPCM)							
Total	1.39	1.37	1.32	1.29	1.30	1.37	1.34
Milk allocation	1.10	1.09	0.99	1.00	1.01	1.08	1.05
Cash crop allocation	0.06	0.06	0.13	0.09	0.09	0.01	0.02
Mineral balance (g/kg FPCM)							
N	12.5	10.92	13.36	11.71	12.4	14.5	13.44
P	1.86	2.70	0.36	0.89	0.77	1.20	2.03

[1]Fat- and protein-corrected milk.

M165 Canopy height effect on the fiber digestibility of elephantgrass under cut and carry systems. E. B. Alves[1], D. M. Donnelly*[2], J. R. R. Dorea[2], F. L. M. Silva[3], T. Bernardes[1], and D. K. Combs[2], [1]*Federal University of Lavras, Lavras, MG, Brazil,* [2]*University of Wisconsin, Madison, WI,* [3]*University of Sao Paulo, Piracicaba, SP, Brazil.*

The objective of this study was to evaluate how canopy heights (1.00, 1.40, 1.80, 2.20 and 2.60 m) affect fiber digestibility of elephantgrass (*Pennisetum purpureum* cv. Cameroon). The experiment was conducted in 25 plots with 6 rows each in Lavras, MG, Brazil. Harvests were performed from Oct/2014 to Oct/2016. The experimental period was divided in 4 periods, 2 rainy seasons (RS) and 2 dry seasons (DS). The plants used for the evaluations were harvested at soil level. Forages were analyzed for aNDF with the Ankom procedure with NDF solution containing amylase and sulfite. Fiber digestibility was measured by the total-tract NDF digestibility (TTNDFD) in vitro method. Indigestible NDF (iNDF) of the samples was obtained via 240 h in situ incubation in 2 cannulated dairy cows. A randomized complete block design with 5 replications was used. Data were analyzed with PROC MIXED in SAS, and canopy height (CH), season and its interaction were considered fixed effects. There were differences between all variables ($P < 0.01$) between RS and DS. No differences in any of the measured variables were seen between the 2 RSs or between the DSs. Regressions to determine linear relationships were performed using PROC REG of SAS. For the RSs, there was a linear increase on aNDF ($R^2 = 0.82$; $P < 0.001$) and iNDF ($R^2 = 0.84$; $P < 0.001$) content with the increase of the CH. A linear ($R^2 = 0.74$; $P < 0.001$) reduction in TTNDFD values occurred with the increase of the CH, with the same reduction observed for the digestion rate k_d ($R^2 = 0.77$; $P < 0.001$). During the DS, the NDF and iNDF values were greater ($P < 0.0001$) than during the wet seasons for all treatments. NDF and iNDF also increased linearly ($R^2 = 0.79$; $P < 0.001$ and $R^2 = 0.81$; $P < 0.001$ respectively) as the CH increased during the DS. The TTNDFD of plants harvested during the DSs were lower ($P = 0.0065$) than in plants harvested during the RS, and the TTNDFD values decreased linearly ($R^2 = 0.72$; $P = 0.0423$) with the increase of the CH. The digestion rate also decreased linearly ($R^2 = 0.724$; $P = 0.0223$) with the increase in CH. As CH increased, the fiber digestibility of elephantgrass decreased.

Key Words: TTNDFD, elephantgrass, fiber digestibility

M166 Effects of irrigation on sorghum forage yield and quality in the central sands region of Wisconsin. A. Grisham*[1], M. Akins[1], E. Remick[1], H. Su[2], R. Ogden[3], and W. Coblentz[3], [1]*Department of Dairy Science, University of Wisconsin-Madison, Madison, WI,* [2]*College of Animal Science and Technology, China Agricultural University, Beijing, China,* [3]*US Dairy Forage Research Center, Marshfield, WI.*

A study was conducted to assess effects of irrigation on yield and quality of photoperiod sensitive (PS) and non-PS forage sorghums in comparison to corn in central Wisconsin. Treatments were arranged as a split-plot with a randomized complete block design with 3 replications. Five irrigation rates (0, 25, 50, 75, and 100%) relative to corn water needs were applied using a linear irrigation system with each rate applied as one strip. For practical purposes, the 0% rate was in a different field at the station with a similar soil type. Irrigation rates were attained using irrigation nozzles with different flow rates. Within irrigation rate strip, cultivars (corn, PS forage sorghum, PS sorghum-sudangrass, forage sorghum, BMR forage sorghum, sorghum-sudangrass, BMR sorghum sudangrass, PS BMR sudangrass) were randomly assigned within 3 replicate blocks. Plots were established June 2, 2016 and harvested using a single harvest at 1/3 to 1/2 corn kernel milk-line, soft to hard-dough stage or after a frost for sorghums. Data were analyzed using the MIXED procedure of SAS 9.4. Precipitation as rain was 62.2 cm; irrigation totals were 7.4, 14.9, 22.4, and 29.8 cm for 25, 50, 75, and 100% rates, respectively. Cultivars interacted with irrigation rate (Table 1; $P = 0.04$) with PS varieties and BMR forage sorghum most responsive to greater irrigation rates, corn having moderate responses, and forage sorghum, sorghum-sudangrass and sudangrass being less responsive. This may be due to PS varieties exhibiting no reproductive growth until harvest. Sorghum-sudangrass and forage sorghum have potential to be grown with less irrigation and have high forage yields.

Table 1 (abstract M166). Dry matter yields (kg/ha) for sorghums and corn at various irrigation rates

	Irrigation rate (%)				
Variety	0	25	50	75	100
Corn	15,508	15,053	17,338	19,301	22,452
PS forage sorghum[1]	20,384	23,498	35,407	39,782	37,438
PS sorghum-sudan	21,108	26,917	31,666	38,752	44,457
Forage sorghum	26,089	24,707	25,163	26,805	31,465
Sorghum-sudan	19,787	19,249	25,095	25,977	21,691
BMR forage sorghum	15,915	22,624	21,273	29,837	34,787
BMR sorghum-sudan	18,510	18,928	19,428	18,674	24,633
PS BMR sudangrass	21,280	23,378	19,749	28,426	24,603
SEM			3,536		
Variety × Irrigation (*P*-value)			0.04		

[1]PS = photoperiod sensitive.

Key Words: irrigation, sorghum forage

M167 Packing density of corn and winter forage silage structures on California dairies. M. Cuffia*[1], J. Lawrence[2], J. Heguy[3], and N. Silva-del-Rio[1], [1]*University of California, Veterinary Medicine Teaching & Research Center, Tulare, CA,* [2]*Alltech, Fresno, CA,* [3]*University of California, Agriculture & Natural Resources, Modesto, CA.*

The aim of this study was to describe packing density of corn (n = 177) and winter forage (n = 73) silage structures on 99 California dairies. Dairies were visited at least once from 2010 to 2016. To determine density, silage structures were probed at 3 different face locations (right, middle and left) at 1.8 m from the bottom surface. Cut length was evaluated with a measuring tape. Silage samples were composited and a sample was sent to a commercial lab for dry matter (DM) determination. The overall density for each of the silage structures was calculated as an average of the 3 samples collected. Descriptive statistics, including first (Q_1), second (Q_2) and third (Q_3) quartiles as well as means, range and coefficient of variation (CV) were computed with the UNIVARIATE procedure of SAS. Means comparisons were performed with TTEST procedure of SAS. Corn silage structures were conventional piles (n = 118), bunkers (n = 6), bags (n = 10), rollover piles (n = 36), or hybrid piles (n = 7). Winter forage silage structures were conventional piles (n = 45), rollover piles (n = 18), bags (n = 8) or hybrid piles (n = 2). Average cut length was 1.7 cm (range: 1.3 to 2.2 cm) for corn silage and 1.6 cm (range: 1.3 to 1.9 cm) for winter forage. Corn silage DM was 34% (range: 28 to 45% of DM), while winter forage was 32% (range: 27 to 45% of DM). Corn silage structures had a higher ($P < 0.01$) packing density at the bottom-middle (269 kg of DM/m^3) than at the bottom-right (247 kg of DM/m^3) or bottom-left (239 kg of DM/m^3). Average packing density was 223 (Q_1), 251 (Q_2) and 280 (Q_3) kg of DM/m^3 for corn silage. In winter silage structures, higher ($P < 0.01$) packing density was observed at the bottom-middle (184 kg of DM/m^3) than at the bottom-right (160 kg of DM/m^3) or bottom-left (160 kg of DM/m^3). Average packing density for winter forage was 135 (Q_1), 168 (Q_2), and 205 (Q_3) kg of DM/m^3. In the bottom-middle sample location,75% of corn silage structures were above 240 kg of DM/m^3, whereas 50% of winter forage structures were below 183 kg of DM/m^3. Bagged silage was below recommended minimum packing densities for both corn and winter forage. California silage structure density can be improved, especially in winter forage structures.

Key Words: corn silage, winter forage, packing density

M168 Nitrogen fertilization effects on sorghum forage yield and quality. A. Grisham*[1], M. Akins[1], E. Remick[1], H. Su[2], R. Ogden[3], and W. Coblentz[3], [1]*Department of Dairy Science, University of Wisconsin-Madison, Madison, WI,* [2]*College of Animal Science and Technology, China Agricultural University, Beijing, China,* [3]*US Dairy Forage Research Center, Marshfield, WI.*

The study objective was to determine the effect of N fertilization on yield and quality of photoperiod sensitive (PS) and non-PS sorghums compared with corn. This study was done in a randomized complete block design with treatments arranged in a 4 × 8 factorial with 3 replicate blocks. Within each block, N rates (0, 56, 112, and 168 kg N/ha) were randomized with 7 kg N applied as urea by hand at planting and the remaining N applied at the 4–6 leaf stage. The 0 kg N/ha application rate did not receive pre-plant N. Within each N rate, varieties (corn, PS forage sorghum, PS sorghum-sudangrass, forage sorghum, brown midrib (BMR) forage sorghum, sorghum-sudangrass, BMR sorghum sudangrass, PS BMR sudangrass) were randomly assigned. Plots were planted June 3, 2016 and harvested at 1/3 to 1/2 kernel milk-line for corn, soft to hard-dough for sorghum, or after a killing frost. Data were analyzed using MIXED procedure of SAS. The interaction of variety and N rate was not significant ($P = 0.67$). Nitrogen rate affected yield (Table 1; $P = 0.02$) with reduced yield for 0 kg N/ha plots compared with 56 kg N/ha, 112 kg N/ha, and 168 kg N/ha plots (11375 vs 17199, 16627, 18981 kg DM/ha respectively). However, there were no significant differences in yield across N rates of 56, 112, and 168 kg N/ha ($P = 0.21$). Yield was affected by variety (Table 1; $P < 0.01$) with PS varieties, forage sorghum, and BMR forage sorghum having greater yields than BMR sorghum-sudangrass, sudangrass, and corn. Overall, some sorghum varieties can provide excellent yields of forage with modest N fertilization in central Wisconsin.

Table 1 (abstract M168). Dry matter yields (kg/ha) for sorghums and corn using nitrogen rates in WI in 2016

	Nitrogen rate (kg/ha)			
Variety[1]	0	56	112	168
Corn	12,391	11,499	14,127	15,717
PS forage sorghum	9,983	21,399	21,885	25,118
PS sorghum-sudan	11,715	18,726	21,302	23,647
Forage sorghum	13,410	20,660	19,130	20,250
Sorghum-sudan	13,836	17,278	15,269	20,085
BMR forage sorghum	14,205	24,289	17,226	21,332
BMR sorghum-sudan	8,609	14,859	12,566	13,306
PS BMR sudangrass	6,854	8,885	11,514	12,395
SEM		3,181		
Variety × Irrigation (*P*-value)		0.67		

[1]PS = photoperiod sensitive; BMR = brown midrib.

Key Words: sorghum forage, corn, nitrogen fertilization

M169 Pearl millet morphological composition at three sowing densities and two cutting heights. J. S. Trindade[2,1], V. L. Banys[1], M. Dias[1], F. J. S. Dias[1], and E. A. Collao-Saenz*[1], [1]*Universidade Federal de Goiás-UFG, Jataí, Goiás, Brazil,* [2]*UNIVAR, Barra do Garças, Mato Grosso, Brazil.*

West Central region of Brazil presents a well-defined dry season during the winter and a rainy summer season, therefore, forage alternatives such as pearl millet are evaluated to reduce the effects of the dry period. The objective of this study was to evaluate the morphological composition of millet at the south-east region of Goias State of Brazil.

Plots were disposed in a completely randomized block design using a 3 × 2 factorial arrangement (3 sowing densities: 10, 15 and 20 kg.ha-[1] and 2 cutting heights: 50 and 70 cm) with 20 cm residual height and 6 replicates. The samples were collected at 3 points in the plots and separated and weighed in stem, leaves, dead/senescent material and panicles. Statistical analyzes were performed at 5% probability and means comparison evaluated by Tukey test. There was no significant effect of seeding density on the plant structural fractions nor interaction between sowing density and cutting height. Average values for leaf, stem, panicle and dead matter fractions were 27.24; 46.26; 19.63 and 6.42, respectively, showing a compensatory effect of the sowing rate on the plant components distribution, which allowed that the canopy structure was preserved even when sown changed the final population (53, 68 and 78 plants/m^2, respectively for 10, 15 and 20 kg seeds/ha densities). The effect of cutting height was significant for all fractions (Table 1). The higher cutting height decreased the leaves percentage and increased the stem percentage resulting in a lower leaf/stem ratio, probably due the longer period necessary to reach 70 cm height, with maturity, the plants also presented higher percentage of panicle and dead material. Considering that the grazing aims harvesting green leaves and a longer grazing period, it is recommended to use millet management at 50 cm.

Table 1 (abstract M169). Morphological composition of millet off-season on two cutting heights

	Cutting Height (cm)			
Fraction (%)	50	70	CV (%)[1]	*P*-value[2]
Leaf	35.75	18.74	15.80	<0.01
Stem	44.63	47.89	4.24	<0.01
Panicle	14.54	24.72	7.09	<0.01
Dead material	4.67	8.39	27.12	<0.01

[1]Coefficent of variation.

[2]*F* test.

Key Words: flowering, grass, leaf/stem ratio

M170 Effect of plant population and hybrids varying in relative maturity on yield, nutrient composition and ruminal in vitro NDF digestibility in whole-plant corn forage. L. F. Ferraretto*[1], J. G. Wasdin[1], C. R. Staples[1], and D. Grabow[2], [1]*University of Florida, Gainesville, FL,* [2]*Grabow Seed Services Inc., Atlanta, GA.*

The objective of this study was to evaluate the effect of plant population and hybrid relative maturity on yield, nutrient composition and ruminal in vitro NDF digestibility at 30 h (ivNDFD) in whole-plant corn forage. Five hybrids varying in relative maturity (115 [M115], 118 [M118a, M118b], 124 [M124] and 130 [M130] days) were each planted at 2 different plant populations (60,000 [60K] or 70,000 [70K] plants/hectare) during the summer, in quadruplicate. Samples were analyzed via NIRS at Dairyland Labs (Arcadia, WI). Data were analyzed as a completely randomized design using Proc Glimmix of SAS with the Fixed effects of hybrid, plant population, and their interaction. A plant population × hybrid interaction was observed ($P = 0.001$) for DM content, with greater values observed for 70K than 60K on M118a (33.9% vs. 32.1%) but the opposite on M118b (28.6% vs. 31.1%). Despite the greater ($P = 0.02$; 8.9% vs. 8.3%) CP content for 60K than 70K, plant population did not affect ($P > 0.10$) ADF, aNDFom, and starch concentrations. Greater starch (40.0% vs. 26.3% on average) but reduced CP (7.5% vs. 8.0% on average), ADF (22.7% vs. 28.8% on average) and aNDFom (36.0% vs. 44.7% on average) concentrations were observed ($P < 0.01$) for M118a than other hybrids. Increasing plant population from 60K to 70K tended ($P = 0.08$) to increase ivNDFD by 1.5%-units. This is related to reduced lignin ($P = 0.02$; 4.5% vs. 4.0%) and a trend for decreased uNDFom240 ($P = 0.09$; 14.3% vs. 13.0) concentrations for 70K. Yield of DM, milk/t and milk/ha were unaffected by plant population and averaged 13.2 t of DM/ha, 1263 kg of milk/t of DM, and 13952 kg of milk/ha, respectively. In addition, M118a tended to have greater ivNDFD ($P = 0.06$; 51.1 vs. 47.4% of NDF on average). This is related to the 1.1%- and 4.0%-unit lower ($P < 0.01$) lignin and uNDFom240 concentrations, and led to enhanced ($P = 0.01$) milk/t and milk/ha estimates. Yield of DM was 1.2 t/ha greater ($P = 0.01$) for M130 than other hybrids, on average. Plant population slightly improved NDF digestibility whereas hybrids varying in relative maturity affected yield and quality of whole-plant corn forage.

Key Words: corn silage, plant population, NDF digestibility

M171 Productivity of lactating dairy cows fed diets with teff hay as the sole forage. B. Saylor*, D. Min, and B. Bradford, *Kansas State University, Manhattan, KS.*

Groundwater depletion is one of the most pressing issues facing the dairy industry today. One strategy to improve the industry's drought resilience involves feeding drought tolerant forage crops in place of traditional forage crops like alfalfa and corn silage. The objective of this study was to assess the productivity of lactating dairy cows fed diets with teff hay (Eragrostis tef) as the sole forage. Teff is a warm-season annual grass native to Ethiopia that is well adapted to drought conditions. Nine multiparous Holstein cows (185 ± 31 d in milk; mean ± SD) were randomly assigned to 1 of 3 diets in a 3 × 3 Latin square design with 18-d periods (14 d acclimation and 4 d sampling). Diets were either control (CON), where dietary forage consisted of a combination of corn silage, alfalfa hay, and prairie hay, or 1 of 2 teff diets (TEFF-A and TEFF-B), where teff hay (13.97 ± 0.32% CP, DM basis) was the sole forage. All 3 diets were formulated for similar dry matter (DM), crude protein (CP) and starch concentrations. CON and TEFF-A were matched for concentrations of neutral detergent fiber (NDF) from forage (18.23 ± 0.15% of DM), and TEFF-B included slightly less, providing 16.63% NDF from forage. Dry matter intake (DMI), milk and component production, body weight (BW), body condition score (BCS), as well as DM and NDF digestibility (DMD and NDFD) were monitored and assessed using mixed model analysis. Treatment had no effect ($P = 0.76$) on DMI (28.14 ± 0.75 kg/d). Similarly, treatment had no effect ($P = 0.65$) on milk production (40.68 ± 1.79 kg/d). Concentrations of milk fat (3.90 ± 0.16%) and lactose (4.68 ± 0.07%) were also unaffected by treatment ($P > 0.10$). TEFF-A and TEFF-B increased milk protein concentration ($P < 0.001$) compared with CON (3.07 vs. 3.16 ± 0.09%). Treatment had no effect on energy-corrected milk (ECM) yield (43.37 ± 1.26 kg/d), BW, or BCS change (all $P > 0.10$). Additionally, treatment had no effect ($P = 0.47$) on total-tract DM or NDF ($P = 0.58$) digestibility. Results from this study indicate that teff hay has potential to replace alfalfa and corn silage in the diets of lactating dairy cattle without loss of productivity.

Key Words: drought, teff hay, dairy cattle