T108 Application of a handheld infrared meter for determining silage moisture. J. J. Blackburn*[1], R. G. Bonner[2], J. P. Goeser[3], C. I. Vahl[1], and M. J. Brouk[1], [1]*Kansas State University, Manhattan, KS,* [2]*Topcon Agriculture Americas, Fort Atkinson, WI,* [3]*Rock-River Laboratories, Watertown, WI.*

This study compared the accuracy of 3 handheld near infrared spectrophotometer (NIRS) units (Digi-Star Moisture Tracker, Fort Atkinson, WI) and 2 on-farm testing methods for predicting DM to conventional oven drying at 60°C of corn silage. Corn silage samples (1,500 g) were obtained from 4 commercial farms in Kansas and analyzed for DM daily for 20 d. Two calibrations were also tested within each unit: NIRu was the DM predicted from the factory-preset calibration, and NIRc was a bias-adjusted DM prediction based on the average difference oven-dried corn silage and NIRu over the 20-d experiment. The NIRc was determined after the experiment was completed. Each sample was scanned 20 times by each NIRS unit and the average predicted DM was recorded as the DM. This process was replicated 3 times with each NIRS unit. Two duplicate 100-g subsamples were dried by 3 different methods: food dehydrator at 71°C (Nesco, Two Rivers, WI), 71, Koster Tester (Koster Moisture Tester Inc., Brunswick, OH), and 60°C oven. The 60°C oven samples were dried for 48 h and then dried in a 105°C oven for 24 h to obtain the final DM daily. Data were analyzed using PROC MIXED (SAS, version 9.4), with method, method × farm, and method × day as fixed effects and equipment as a random effect. Average Oven DM of corn silage was 36.21% for the 20-d experiment. The 3 NIRu predictions of 35.87 ± 0.5957, 32.43 ± 0.5957, and 32.97% ± 0.5957 were significantly different from the corn silage oven value of 36.21% DM ($P < 0.05$). While all 3 NIRc predictions of 36.20 ± 0.7407, 36.25 ± 0.7407, and 36.20% ± 0.7407 were similar to oven DM value of 36.21% for corn silage ($P > 0.05$). The DM predictions for the food dehydrator and Koster Tester of 38.73 ± 0.7407 and 38.22% ± 0.7407 respectively, were significantly different from oven-dried DM for corn silage ($P < 0.05$). The handheld NIRS units accurately predicted DM content of the corn silages when the factory preset calibrations were corrected for bias, while the food dehydrator and Koster Tester overestimated the DM of the corn silage.

Key Words: corn silage, dry matter, near-infrared

T109 Energy-dispersive X-ray fluorescence (EDXRF) as a comprehensive method for mineral analysis of feeds. R. Ward*[1], D. Ye[2], A. Buman[2], D. Pecard[2], and D. R. Mertens[3], [1]*Cumberland Valley Analytical Services, Waynesboro, PA,* [2]*Bruker AXS Inc., Madison, WI,* [3]*Mertens Innovation & Research LLC, Belleville, WI.*

The objective was to evaluate EDXRF for measuring mineral concentrations in feeds and mixtures. When an X-ray tube radiates a sample, secondary X-ray photons are emitted with specific energies that generate spectral peaks related to individual elements. Heights of peaks can be calibrated to calculate element concentrations. Calibration samples included 20 TMR, 10 corn grain, 10 corn silages, 12 legume and 8 grass forages that were analyzed for Ca, P, Mg, K, Na, Fe, Mn, Zn, and Cu by ICP; S by combustion analysis; and Cl by titration. Typically, samples are finely ground (0.2 mm) and pelleted for EDXRF, but for this evaluation samples were ground through a 1.0 mm screen in a cyclone mill and 5 g of loose powder was placed in a 40-mm cup and covered with 3.0-um Prolene film before scanning for 9 min. The EDXRF instrument was a Bruker S2 PUMA with SPECTRA.ELEMENTS software used for calibration. Elements Na, Mg, P, S, and Cl were measured with 20 kV and no filter, and K, Ca, Mn, Fe, Cu, and Zn were measured with 40 kV and a 500-µm Al filter. Tube current was automatically adjusted. Mineral concentration ranges were typical for feeds and mixtures. High R^2 and low standard deviation of linear regression (SD) in the table indicate excellent agreement between analytical and EXDXRF results at selected peaks. Instrument precision was excellent when the same sample was scanned 10 times. When scanning time was reduced to < 5 min, there was a small loss in precision and accuracy. The results (Table 1) indicate that using EDXRF with routine feed sample preparation offers an excellent alternative for mineral analysis in feeds and mixtures.

Key Words: trace mineral

T110 Effect of corn planting population on phosphorus concentration and extraction in the forage (study 1). G. Ferreira* and C. Teets, *Department of Dairy Science, Virginia Tech, Blacksburg, VA.*

The objective of this on-farm study was to determine the effects of corn planting population on forage yield, plant phosphorus (P) concentration, and P removal from the soil. The study was performed during the

Table 1 (Abstr. T109).

Element	n	Range (in DM; %)	R^2	SD	Peak (keV)	Precision (%)
Ca	58	0.01 to 2.65%	0.986	±0.07%	3.696	±0.01%
P	57	0.15 to 0.60%	0.959	±0.02%	2.016	±0.00%
Mg	60	0.09 to 0.53%	0.941	±0.03%	1.251	±0.01%
S	53	0.10 to 0.48%	0.974	±0.02%	2.311	±0.00%
K	54	0.35 to 3.91%	0.994	±0.07%	3.302	±0.00%
Cl	51	0.00 to 1.88%	0.993	±0.026%	2.635	±0.00%
Na	60	0.01 to 0.72%	0.942	±0.05%	1.047	±0.01%
Fe	57	20.8 to 1821 ppm	0.994	±26.0 ppm	6.400	3.50 ppm
Mn	58	4.61 to 138.3 ppm	0.963	±7.11 ppm	5.895	±1.04 ppm
Zn	60	13.4 to 133.5 ppm	0.986	±3.47 ppm	8.632	±1.71 ppm
Cu	59	1.23 to 24.9 ppm	0.956	±1.35 ppm	8.044	±0.44 ppm

spring and summer seasons of 2014 and 2015 at 2 commercial dairy farms located in Virginia. The study included 7 cornfields with different growing and harvesting conditions. In each cornfield, corn was planted in plots at a theoretical seeding rate of 55,000, 70,000, 85,000, and 100,000 seeds/ha (55K, 70K, 85K, and 100K, respectively). Each seeding rate had 4 replicates within each cornfield. Corn was planted with no-till planters. For all cornfields, the preceding crop was annual ryegrass that was harvested for silage within 10 d before planting corn. Fertilization was the same for all plots and followed nutrient management plans of each farm. At harvesting time, 10 plants from each plot were cut by hand (15 cm above ground), weighed, chopped, mixed, and analyzed for DM and P concentrations. All variables were analyzed using the MIXED procedure of SAS. The statistical model included the effects of field (fixed; 6 df), planting density (fixed; 3 df), planting density nested within field (fixed; 18 df), and the random residual error. Plant DM biomass decreased linearly when planting density increased (376 vs. 253 g of DM/plant for 55K and 100K, respectively; $P < 0.01$), whereas DM yield increased linearly when planting density increased (19.8 vs. 26.0 Mg/ha for 55K and 100K, respectively; $P < 0.01$). The concentration of P in the fresh forage was highest ($P < 0.01$) for 55K and 70K (0.250% DM) and lowest for 85K and 100K (0.235% DM). The removal of P through the harvested biomass increased linearly ($P < 0.01$) when increasing corn planting density (14.0, 16.8, 19.2, and 23.2 kg P/ha for 55K, 70K, 85K, and 100K, respectively). In conclusion, increasing corn planting density decreased P concentration in the corn plant and increased P removal from the field.

Key Words: phosphorus, corn silage, corn planting density

T111 Effect of corn planting population on phosphorus concentration and extraction in the forage (study 2). G. Ferreira and C. L. Teets*, *Department of Dairy Science, Virginia Tech, Blacksburg, VA.*

The objective of this on-farm study was to determine the effects of corn planting population on forage yield, plant phosphorus (P) concentration, and P removal from the soil. The study was performed on a 200-cow dairy farm located in Virginia. In 2 cornfields, 2 corn hybrids (conventional and BMR) were planted in plots at a theoretical seeding rate of 60,000, 80,000, and 100,000 seeds/ha (LOW, MID, and HIGH, respectively). Each seeding rate had 4 replicates within each cornfield. Corn was planted with a 6-row no-till planter. Plots were 3 (3) 30.5-m long rows separated by 76 cm. Pre-planting fertilization included 112 kg N/ha. The resulting populations were 64,000, 75,000, and 87,000 plants/ha for LOW, MID, and HIGH, respectively. At V6, half of each plot was fertilized with 51 kg N/ha and the other half was fertilized with 102 kg N/ha. At early-dent stage of maturity, 10 plants from each plot were cut by hand (15 cm above ground), weighed, chopped, mixed, and analyzed for DM and P concentrations. Data were analyzed as a split-plot in a completely randomized design. The model included the fixed effects of field, hybrid, planting density, fertilization, and all their interactions, and the random effects of whole and split-plot errors. Dry matter yield tended to differ among planting populations ($P < 0.06$), being greatest for LOW and HIGH (19.2 Mg/ha) and lowest for MID (17.8 Mg/ha). Dry matter yield was greater ($P < 0.01$) for the conventional than for the BMR hybrid (20.6 and 16.9 Mg/ha, respectively). Doubling N fertilization at V6 increased DM yield ($P < 0.03$) from 18.2 to 19.3 Mg/ha. No interaction was observed between planting population and N fertilization ($P > 0.22$). The concentration of P in the forage differed among planting populations ($P < 0.01$), being greatest for LOW (0.249% DM) and lowest for MID and HIGH (0.226% DM). Total P removed differed among planting populations ($P < 0.01$), being greatest for LOW and HIGH (46 kg P/ha) and lowest for MID (40 kg P/ha). In conclusion, under the conditions of this study, high corn planting population resulted in similar DM yields and P removals to those obtained with low planting population, and the concentration of P was reduced at high planting populations.

Key Words: corn silage, planting population, phosphorus

T112 Effect of bacterial inoculants containing *Lactobacillus buchneri* and/or *Lactobacillus hilgardii* on the fermentation and quality of corn silage. K. G. Arriola*, D. Vyas, D. Kim, M. C. Agarussi, V. P. Silva, J. M. Flores, Y. Jiang, A. A. Pech-Cervantes, and A. T. Adesogan, *Department of Animal Sciences, University of Florida, Gainesville, FL.*

The objective was to determine the effect of *Lactobacillus buchneri* and/or *Lactobacillus hilgardii* inoculation on the fermentation and chemical composition of corn silage. Two corn hybrids harvested at either 34 or 43.8% DM (Experiment 1 or 2) were chopped and ensiled in vacuum-sealed bags (40 × 61cm) for 30 and 90 d. Treatments included (1) deionized water (CON) or inoculants containing (2) *Lactobacillus buchneri* (1.5×10^5 cfu/g, LB); (3) *Lactobacillus hilgardii* (1.5×10^5 cfu/g; LH); and (4) *Lactobacillus buchneri* and *L. hilgardii* (1.5×10^5 cfu/g of each inoculant, LB+LH). Samples collected from d 0, 30, and 90 were analyzed for chemical composition and microbial counts. Aerobic stability was measured at d 30 and 90. Data for each experiment were analyzed separately with the Glimmix procedure of SAS for a completely randomized design. In Experiment 1 (34% DM) d 30 samples, inoculation tended to reduce lactate to acetate ratio (6.5 vs. 6.9; $P = 0.07$) and increase aerobic stability (301 vs. 197 h; $P = 0.07$) and LH and LB+LH reduced the pH compared with CON. In d 90 samples, inoculation increased aerobic stability (488 vs. 400 h) and LAB counts compared with CON (7.93 vs. 6.34 log cfu/g; $P < 0.0001$). Also, LH reduced yeast counts relative to CON and LB+LH reduced lactate concentration relative to CON and LB. In Experiment 2 (43.8% DM) d 30 samples, LH reduced DM loss relative to LB (1.89 vs. 9.07%) and LB increased acetate relative to other treatments; inoculation increased ($P < 0.0001$) LAB counts, and reduced lactate concentration (tendency) and yeast counts compared with CON. In d 90 samples, inoculation increased LAB counts (8.91 vs. 6.96 log cfu/g; $P < 0.0001$) and reduced yeast counts (0 vs. 2.38 log cfu/g; $P = 0.003$) compared with CON. In conclusion, inoculating a corn hybrid harvested at 34% with LB, LH, and LB+LH improved LAB counts and aerobic stability after 30 or 90d of ensiling. However, inoculating a hybrid harvested at 43.8% DM improved LAB counts and reduced yeast counts at d 30 and 90 but did not affect aerobic stability.

Key Words: corn silage, *Lactobacillus buchneri*, *Lactobacillus hilgardii*

T113 Meta-analysis of the effect of *Lactobacillus buchneri* inoculation on dry matter recovery and aerobic stability of silages. K. G. Arriola*[1], A. S. Oliveira[2], Y. Jiang[1], I. M. Ogunade[1], D. Kim[1], H. M. Silva[2], F. X. Amaro[1], A. A. Pech-Cervantes[1], S. C. Kim[3], H. Sultana[1], D. Vyas[1], L. F. Ferraretto[1], and A. T. Adesogan[1], [1]*Department of Animal Sciences, University of Florida, Gainesville, FL,* [2]*Institute of Agriculture and Environmental Sciences, Universidade Federal de Mato Grosso, Sinop, Brazil,* [3]*Division of Applied Life Science, Gyeongsang National University, Jinju, South Korea.*

A meta-analysis of 103 peer-reviewed papers was conducted to examine effects of inoculation with *Lactobacillus buchneri* (LB) or homolactic

and or facultative heterolactic acid bacteria (HAB) in combination with LB (LB+HAB) on silage DM recovery and aerobic stability. Raw mean differences (RMD) between inoculant and control treatment means that had been weighted by inverse variance using random models were compared. Heterogeneity sources evaluated included forage type, application rate (AR; $< 10^4$, 10^5, 10^6 or $>10^7$ cfu/g as fed, bacteria type (LB vs. LB plus each of various HAB), enzyme inclusion, ensiling duration and silo type (laboratory or farm-scale) as covariates. Inoculation increased aerobic stability (RMD = 95 ± 52h, $P < 0.01$, n = 163) and DM recovery (RMD = 0.81 ± 0.75%, $P = 0.04$, n = 112) but high heterogeneity was detected (I^2 statistic = 99.8 and 98.3%, respectively). Enzyme use, ensiling duration or silo type did not affect aerobic stability or DM recovery and AR did not affect aerobic stability. Inoculation did not affect the aerobic stability of silages of tropical grasses (RMD = 12 ± 21 h, n = 6), but tended to increase those of corn (RMD = 84 ± 61 h, $P = 0.06$, n = 66), temperate grasses (RMD = 102 ± 18 h, $P < 0.01$, n = 44), alfalfa (RMD = 71 ± 26 h, $P < 0.01$, n = 3), other legumes (RMD = 24 ± 8 h, $P < 0.01$, n = 5), high moisture grain (RMD = 174 ± 35 h, $P < 0.01$, n = 17) and other crops (RMD = 61 ± 46 h, $P < 0.04$, n = 22). The LB and LB+HAB types similarly increased aerobic stability ($P > 0.10$), except LB plus *L. plantarum* (LP) and *Enterococcus faecium* (EF), which had no effect (RMD = 17 ± 32 h, $P = 0.31$, n = 22). Forage or bacteria type did not affect DM recovery, but unlike higher doses, inoculation with 10^5 cfu/g increased DM recovery (RMD = 1.22 ± 0.66%, $P < 0.01$, n = 88). Inoculation with LB alone or combined with HAB (except LB+LP+EF) markedly improved the aerobic stability of corn, alfalfa and other legumes, temperate grasses and high moisture grain, but not tropical grasses. Inoculation also increased DM recovery when applied at 10^5 cfu/g but not at higher doses.

Key Words: *Lactobacillus buchneri*, aerobic stability, silage

T114 Impacts of silage bacterial additives on forage fiber. P. Drouin*[1], S. Ordaz[2], and P. Sivakumar[3], [1]*Lallemand Specialities Inc., Milwaukee, WI,* [2]*University of Vermont, Burlington, VT,* [3]*Lallemand Inc., Lebanon, NH.*

Silage fermentation involves the metabolic activity of lactic acid bacteria, but classical microbiology and next generation sequencing approaches show that several other microorganisms are also active during different phases of fermentation. Carbohydrate-active enzymes from microorganisms and from the plant cells are released and will bind to plant cell walls to initiate degradation. Inoculation of the forage may modify the succession of the microbial population, which would in turn induce modifications to the quality of the fiber. To test this hypothesis, one ensiling trial with corn (37.5% DM-5.2kg/unit) and one with alfalfa (40.0%DM-5.5kg/unit) were performed. The forages were inoculated with one of 4 inoculants (*Lactobacillus plantarum*, *Pediococcus pensosaceus*, *Lactobacillus buchneri*, and mixed inoculants of *Lactobacillus buchneri* and *Lactobacillus hilgardii*) and compared with a negative control. Six independent repetitions were performed. For both trials, the experimental mini-silos (7-L) were opened after 40 and 120 d of fermentation. The silage digestibility was quantified by measuring undigested neutral detergent fiber (NDF). Fermentation quantification and digestibility data were analyzed by ANOVA (treatment × repetition). The size distribution of particles after grinding at 1 mm on a Wiley grinder was measured using laser reflectance technology and analyzed by PCA and LDA. Lastly, changes in carbohydrates were determined by glycome profiling using antibodies targeting branching and terminal fractions of cell wall polysaccharides. Results from NDF digestibility, particles size distribution, and glycome profiling allowed grouping of treatments according to the type of inoculant. Whatever the forage considered, principal component analysis grouped together samples inoculated with heterolactic strains against inoculation with homolactic strains based on digestibility and fiber strength. Glycome profiling showed that xyloglucan concentration was decreased by the microbiota developed in the presence of the heterolactic strains, while glucuronoxylan profile was mostly affected by the microbiota associated with homolactic strains. Either directly or by orienting succession of microbial communities, silage inoculants contribute to the nutritional quality of silage.

Key Words: forage, silage inoculant, fiber

T115 Pasture base dairy farm intensification: the role of growth strategy (stocking rate vs. individual milk production) and availability of infrastructure. M. Aguerre*[1], M. N. Méndez[1], S. Torterolo[1], and P. Chilibroste[2], [1]*Red Tecnológica Sectorial de Lechería, Montevideo, Uruguay,* [2]*Departamento de Producción Animal y Pasturas, Facultad de Agronomía, UdelaR, Paysandú, Uruguay.*

The aim of this work was to evaluate in pasture based commercial dairy farms the effect of different productive strategies linked to different combinations of stocking rate (SR, cow/ha), and individual milk production (IMP, L/cow/day) and the availability and condition of the infrastructure to fed the animals, on productivity, diet structure and margin over feeding cost. Sixteen dairy farms were categorized according to SR and IMP in 4 groups (n = 4/group): high SR and high IMP (1.51 ± 0.02 and 24.8 ± 0.42; HH), high SR and low IMP (1.44 ± 0.02 and 18.3 ± 0.26; HL), low SR and high IMP (1.09 ± 0.02 and 23.8 ± 0.25; LH) and low SR and low IMP (1.00 ± 0.01 and 16.2 ± 0.23; LL). Farms were visited biweekly (June 2016/May 2017) to record SR, IMP and the diet supplied to milking cows. Once in each season the availability and condition (m^2/cow; mud presence and mud deep around the fed path and the rest

Table 1 (Abstr. T115). Productivity, margin over feeding and animals dry matter intake of pasture based dairy systems with high stocking rate (SR) and high individual milk production (IMP) (HH) high SR and low IMP (HL) low SR and high IMP (LH) and low SR and low IMP (LL)

Item	HH	HL	LH	LL	SEM
Productivity (L/ha/yr)	14,819^{a}	9,527^{bc}	11,498^{ab}	5,986^{c}	1,566
Margin over feeding (U$S/ha/yr)	1,998^{a}	1,443^{bx}	1,451^{bx}	1,004^{by}	114.4
DMI (kg DM/cow/d)					
Herbage	6.93^{b}	7.94^{ab}	6.1^{b}	9.61^{a}	0.621
Conserved forage	5.19^{a}	3.37^{abx}	5.81^{ay}	2.34^{b}	0.629
Concentrate	7.12^{ax}	4.88^{aby}	6.82^{a}	3.47^{b}	0.617

Values within a same row differ at $^{a–c}$ $P \leq 0.05$ or ^{x,y} $P \leq 0.10$.

area) were recorded. All response variables were analyzed with a mix model with farm category as fixed effect and season as random effect. The HH strategy resulted in the highest productivity and margin over feeding cost (Table 1). Strategies based on high IMP use higher levels of supplements despite the stocking rate. No significant differences were detected among strategies on the availability and conditions of fed paths and rest areas. The HH system shows better performance than any other combination of SR and IMP on productivity and margin over feeding despite the availability and condition of the fed path and rest area.

Key Words: infrastructure, stocking rate, individual milk production

T116 Effects of forage allowance on production and pasture use efficiency in Uruguay. A. de Moura Zanine[1], G. P. M. Rebuffo[2], G. S. Oliveira*[1], D. de Jesus Ferreira[1], R. M. Araújo Pinho[1], M. O. M. Parente[1], and H. N. Parente[1], [1]*Universidade Federal do Maranhão, Chapadinha, Maranhão, Brazil,* [2]*Universidade Federal do Mato Grosso, Cuiabá, Mato Grosso, Brazil.*

Pasture utilization per unit of area and pasture intake per cow are major factors determining milk production of grazing dairy cows, both being primarily controlled by pasture allowance (PA). This study aimed to evaluate the effects of pasture allowance (PA) on forage production and pasture use efficiency by Holstein cows during autumn. The experiment was conducted at the Mario Antonio Cassinoni Experimental Station (Universidad de La República), Paysandú-Uruguay, during autumn from April 9 to June 3, 2010. Eighteen hectares of pasture with Tall Fescue (*Festuca arundinacea*) intercropped for the second productive year with legumes white clover (*Trifolium repens*) and bird's-foot-trefoil (*Lotus corniculatus*), was utilized in this study. Total area was divided into 4 blocks of 4.5 ha, and each block was divided into 3 grazing paddocks (GP) of 1.5 ha. Thirty-six Holstein cows calving in the autumn were distributed in the blocks considering: calving date, body weight, and body condition score. Treatments consisted of 3 PA as follows: high (HA, 38.4 kg DM/cow/day), medium (MA, 30.3 kg DM/cow/day), and low (LA, 26.8 kg DM/cow/day). Means were compared using Tukey test ($P \leq 0.05$). Forage mass (4300; 4240 and 4251 kg DM/ha for HA, MA and LA, respectively) and forage height pre-grazing (15.2; 15.0 and 14.9 cm for HA, MA and LA, respectively) were similar ($P \geq 0.05$) for all grazing targets. However, there was a difference ($P < 0.05$) in forage mass and forage height post-grazing due to the difference in pasture allowance between treatments. The forage mass at the beginning of the experiment was high - on average 4264 ± 352 kg of DM/ha. The highest and lowest pasture use efficiency was obtained with treatments LA (51.2%) and HA (33.1%), respectively. The pasture managements with low PA (26.8 kg DM/cow/day) provided better grazing efficiency. Thus, it is possible to reach greater animal performance per area of dairy cows graze mixed pasture swards due increase of stocking rate. However, the impact of higher stocking rates on the persistence of pasture species needs to be investigated.

Key Words: forage mass, grazing management, stocking rate

T117 Milk production and composition of dairy cows in response to pasture allowance. A. de Moura Zanine[1], G. P. M. Rebuffo[2], G. S. Oliveira*[1], D. de Jesus Ferreira[1], R. M. Araújo Pinho[1], M. O. M. Parente[1], and H. N. Parente[1], [1]*Universidade Federal do Maranhão, Chapadinha, Maranhão, Brazil,* [2]*Universidade Federal do Mato Grosso, Cuiabá, Mato Grosso, Brazil.*

Daily pasture allowance (PA) is defined as the product of pregrazing pasture mass and offered area per animal. Determining the optimum PA is not an easy task because it depends on, and varies with, pasture and animal characteristics; however, it is very important because is directly related to farmer decisions. The objective of this study was to evaluate the effects of PA on milk yield and composition of Holstein cows during autumn. The experiment was conducted at the Mario Antonio Cassinoni Experimental Station (Universidad de La República), Paysandú-Uruguay, during autumn from April 9 to June 3, 2010. Eighteen hectares of pasture with Tall Fescue (*Festuca arundinacea*) intercropped for the second productive year with legumes white clover (*Trifolium repens*) and bird's-foot-trefoil (*Lotus corniculatus*) were utilized in this study. Total area was divided into 4 blocks of 4.5 ha, and each block was divided into 3 grazing paddocks of 1.5 ha. Thirty-six Holstein cows calving in the autumn were allocated to blocks considering: calving date, body weight, and body score. Treatments consisted of 3 pasture allowances as follows: high (HA, 38.4 kg DM/cow/day), medium (MA, 30.3 kg DM/cow/day), and low (LA, 26.8 kg DM/cow/day). Means were compared using Tukey test ($P \leq 0.05$). There was an effect of PA on the milk yield per hectare and milk yield per cow. The highest production per hectare was observed in LA (438 L/ha/day) and the lowest in HA (314 L/ha/day). On the other hand, cows increased individually milk production in HA and MA (25.6 and 26.6 L per cow/day, respectively). The content of protein and fat in milk did not differ among treatments. The yield of milk protein from cows in the LA management decreased (718 g/cow/day) compared with MA (846 g/cow/day), but did not differ from HA (820 g/cow/day). Different pasture allowances affected milk production and composition of dairy cows. The LA provided better conditions for milk yield per area, likely due to the better grazing efficiency. Thus, farmers may increase stocking rate to reach higher milk production when lactating dairy cows graze mixed pasture swards.

Key Words: grazing management, milk protein, mixed pasture

T118 Pasture dry matter intake in intensive dairy production systems: Effects of grazing and feeding management. M. N. Méndez*[1], P. Chilibroste[2], and M. Aguerre[1], [1]*Red Tecnológica Sectorial de Lechería, Montevideo, Uruguay,* [2]*Departamento de Producción Animal y Pasturas, Facultad de Agronomía, UdelaR, Paysandú, Uruguay.*

The competitiveness of export based dairy production systems (e.g., Uruguay, New Zealand) is supported by an intensive use of pasture on the diets. The aim of this work was to evaluate which factors linked to feeding and grazing management in commercial dairy farms, determine herbage DMI. Biweekly visits to commercial dairies were carried out between June 2016 and May 2017 to record individual milk production, quantity and type of supplemented on offer, access time to the grazing plots and sward characteristics like sward height, herbage mass and allowance. Herbage DMI (kgDM/cow/d) was determined according to Baudracco et al. (New Zeal. J. Agr. Res., 2010) considering herbage allowance, and by energy balance according to NRC (2001). The dairy farms were categorized in 2 groups according to the differences in DMI between the 2 estimation methods (overall mean ± 15%). Farms that had low differences between both DMI estimation methods were considered farms with high pasture harvesting efficiency (HE, 4.12 ± 1.85 kgMS/cow/d) and farms with large differences were considered farms with low pasture harvesting efficiency (LE, 7.18 ± 0.75 kgMS/cow/d). The 2 groups were compared with the MIXED procedure and considered different when $P \leq 0.10$. No differences were detected between groups in access time to grazing pasture (11.7 ± 4.8 h), sward height (32.1 ± 17.7 cm), herbage mass (2600 ± 1491 kgDM/ha) and herbage allowance (39.7 ± 29.7 kgDM/cow/d). However, HE dairy systems had high pasture and less supplement DMI (kgDM/cow/d) than LE dairy systems

(Table 1). Despite a lower individual milk production in the HE dairy systems, the margin over feeding cost (U$S/cow/d) was not different between groups.

Table 1 (Abstr. T118). Intake, milk production, and margin over feeding cost in dairy systems with high (HE) or low (LE) pasture efficiency use

Item	HE	LE	*P*-value
Herbage intake (kgDM/cow/d)[1]	8.4 ± 0.72	6.5 ± 0.84	0.10
Supplement intake (kgDM/cow/d)	9.2 ± 0.64	14.0 ± 1.10	≤0.01
Milk production (L/cow/d)	20.3 ± 1.02	25.3 ± 1.21	≤0.01
Margin over feeding cost (U$S/cow/d)	4.1 ± 0.30	3.9 ± 0.26	0.60

[1]Estimated by energy balance difference.

Key Words: commercial dairy system

T119 Effect of stocking rate on pasture production and utilization on a grazing dairy system during winter and spring. G. Ortega*[1], T. Nuñez[1], D. Custodio[1], R. Mello[1], Y. Lopez[1], and P. Chilibroste[2], [1]*Agronomy Faculty, Animal Science Department, Progreso, Canelones, Uruguay,* [2]*Agronomy Faculty, Animal Science Department, Grass Production and Utilization on Grazing Systems, Paysandú, Paysandú, Uruguay.*

A farmlet study was conducted to determine the effect of 2 stocking rates [medium (MSR) or high (HSR)] on grass production and utilization. Four farmlets (2 per treatment) on a Uruguayan pasture based dairy system were grazed either with 1.5 (MSR) or 2.0 (HSR) milking cows per hectare from June to December in 2016 and 2017. Nighty 6 cows were randomized to the farmlets based on parity (3.3 + 1.3; 2.1 +1.6), BW (500 ± 91; 520 + 87) and BCS (2.95 ± 0.87; 2.9 + 0.5) for 2016 and 2017, respectively. Every week, the sward mass of each individual plot in each farmlet was assessed through the double sample technique. Based on these observations, herbage intake per hectare was estimated as well as mean growth rate (GR, kgDM/ha/day) for each paddock and the whole farmlet. The grazing area was adjusted weekly based on the GR registered for each treatment. The data were analyzed with a mixed model, which included stocking rate, month (year), as fixed effects. The repeated measurement was week. Differences were declared significant when $P < 0.05$ by Tukey HSD test. Cows grazed a daily strip with a mean herbage allowance above ground of 15.2 vs 13.4 kg DM/cow/d for 2016 ($P < 0.05$) and 18.4 and 15.5 kg DM/d/cow ($P < 0.05$) for MSR and HSR, respectively. Cows on HSR and MSR grazed the same amount of grass (14.5 vs 14.4 kgDM/day/ha) during 2016 but did graze differently during 2017 where HSR cows ate 19.6 vs 14.6 k g DM/day/ha ($P < 0.05$) than MSR cows. Differences in GR (kgDM/ha/day) for the same year were not significant between treatments. Nevertheless, GR was greater in 2016 than in 2017 ($P < 0.05$). The amount of grass harvested in 2016 was higher for MSR (7140 kg DM/ha; 42% grazing:68% haylage) than for HSR (3045 kg DM/ha; 100% grazing). During 2017, total grass harvested was 6339 kg DM/ha for HSR (65% grazing: 35% haylage) and 6441 kg DM/ha for MSR (47% grazing: 53% haylage). Increasing stocking rate (HSR) grazed higher amount of grass per hectare, despite the less harvest opportunity per cow. However, the estrategy of harvest (grazing vs mechanical) will be affected according to stocking rate, where MSR systems were able to harvested more haylage (mechanically).

Key Words: stocking rate, grazing, haylage

T120 Silage feeding programs on intensive dairy farms. T. Bernardes*, M. Cardoso, and L. Lima, *Department of Animal Science, University of Lavras, Lavras, Minas Gerais, Brazil.*

Assessments of feeding programs currently utilized by high-producing dairy herds are important to identify issues and adequate management practices. The aim of this study was to provide silage-feeding programs adopted by intensive dairy farms across the top 6 milk producing Brazilian states. One hundred and 46 farms were surveyed from September 2017 to January 2018 for their feeding practices. Herd managers, and their respective nutritionists, were interviewed by using a common survey form. The form consisted of 21 questions, including information on the characteristics of the herd (n = 5), corn silage (n = 4; whole-plant, high-moisture, reconstituted, and earlage/snaplage), sorghum silage (n = 3; whole-plant, high-moisture, and reconstituted), haylage (n = 5; alfalfa, ryegrass and other crops), other silages (n = 1), hay (n = 1), fresh forage (n = 1), and forage/concentrate ratio (n = 1). The mean, standard deviation, maximum, and minimum of data were calculated using the PROC MEANS procedure of SAS. The number of lactation cows ranged from 26 to 2,020 and daily milk production ranged from 600 to 75,100 L/d. The forage/concentrate ratio ranged from 36/64 to 80/20. Fifty-eight percent of the farms had 2 or more forage sources in the diet. Whole-plant corn silage was fed on all farms, while whole-plant sorghum silage was fed by 6.9% of the farms. High-moisture corn, reconstituted grain corn, and earlage/snaplage were used by 24.8, 16.6, and 3.4% of the farms, respectively. Reconstituted grain sorghum was included in 7.6% of the diets. Thus, more than half of the farms (52.4%) adopted grain silages (corn or sorghum) in the diets. Haylage, hay, and fresh forage were used by 28.3, 45.5, and 31.0% of the farms. Ryegrass and bermudagrass haylage were the most used (56.1 and 39%, respectively). Bermudagrass hay was the most used (68.2%), followed by ryegrass (18.2%) and oat hay (10.6%), respectively. Bermudagrass was also the most used as fresh forage (37.8%). Overall, corn was the most widely grown crop for silage. The majority of herds opted for grain silages as sources of grain in the diet.

Key Words: grain silage, cow feeding program, silage utilization

T121 New approach to properly characterize molasses composition. A. Palmonari[1], L. Mammi[1], D. Cavallini*[1], C. J. Sniffen[2], L. Fernandes[3], P. Holder[3], and A. Formigoni[1], [1]*DIMEVET, Università di Bologna, Bologna, Italy,* [2]*Fencrest LLC, Holderness, NH,* [3]*ED&F Man Liquid Products/Westway Feeds.*

Beet and cane molasses are produced worldwide and widely used in ruminant rations to improve diet palatability and sugar content. However, DM composition is not fully described, and even variability is not considered. Objective of this study was to analyze different molasses to better characterize their composition. Sixteen cane (CM) and 16 beet molasses (BM) were sourced worldwide and analyzed. Gravimetric method was used to determine DM, Kjeldahl for CP, sugars and starch via enzymatic method, minerals by ICP, organic acids and other components in HPLC. Statistical analysis was conducted via ANOVA using the JMP-12 software. Significance was declared for $P < 0.05$. This approach was able to characterize 97.4% and 98.3% DM of CM and BM, respectively. CM showed a numerically lower dry matter content as fed (a.f.) compared with BM (76.8 ± 1.02 vs 78.3 ± 1.61%), as well as CP content (4.8 ± 1.7 vs 10.5 ± 1.1% a.f. $P < 0.05$), with a minimum value of 1% in CM to a maximum of 12% a.f. in BM. The amount of sucrose was higher in BM compared with CM (48.4 ± 1.5 vs 37.5 ± 4.8% a.f. $P < 0.05$), but with great variability even within CM (51.00 max to 33.31 min, % a.f.) and BM (52.00 max to 33.31 min, % a.f.). Glucose and fructose were detected in CM (4.06 ± 2.07 and 6.20 ± 2.17% a.f., respectively),

showing high variability. Organic acid composition differed among molasses. Lactic acid was more concentrated in CM compared with BM (4.69 ± 2.16 vs 3.48 ± 1.37% a.f.), varying from 9.77% maximum to 1.23% minimum within CM, and from 5.55% maximum to 1.37% minimum in BM. Aconitic acid was found only in CM, while glycolic acid in BM. The total sum of acids ranged from 2% to 14% a.f. Sulfates, phosphates, and chlorides had a higher concentration in CM, which showed a lower DCAD compared with BM (4.47 ± 4.97 vs 53.94 ± 33.36 mEq/100g a.f. $P < 0.05$). Within the cane group, it varied from +117.63 to −58.59 mEq/100g a.f., while in beet from +129.20 to +3.24 mEq/100g a.f. In conclusion, data obtained in this study demonstrates the significant differences in molasses composition, highlighting that a more accurate description and characterization is possible and strictly required especially if its use in animal feed is to be fully optimized.

Key Words: molasses, chemical composition, variability

T122 Effects of microbial inoculant and molasses on whole-plant soybean silage harvested in different reproductive growth stages. L. G. Ghizzi, T. A. Del Valle, E. M. de C. Zilio, A. N. Tenório, M. S. S. Dias, J. A. Marques, L. S. Gheller, T. B. de P. Silva, and F. P. Rennó*, *University of São Paulo, São Paulo, São Paulo, Brazil.*

The objective of this study was to evaluate a microbial inoculant and molasses effects on DM losses, dry matter recovered, pH and buffering capacity of whole-plant soybean silage (SS) harvested in different reproductive growth stages. Two hundred mini-silos were used in a completely randomized experiment with treatments in a 5 × 2 × 2 factorial arrangement. Treatments consisted of 5 harvest stages of soybean plant (R3, R4, R5, R6, and R7), 2 levels of molasses inclusion (0 and 40 g/kg of fresh forage), and 2 levels of microbial inoculant inclusion Silobac (Chr. Hansen Industry and Trade Ltda, Valinhos, São Paulo; 0 and 2.5 × 10^{10} cfu/g of a mixture of *Lactobacillus plantarum* and *Pediococcus pentosaceus*). Soybean plants were harvested at 5 cm from the ground, chopped with cut length of 20 mm and ensiled into polyvinyl chloride pipes with 0.5 m length and 0.1 m diameter. Bulk density was set at 650 kg of natural matter/m3. The total DM losses were obtained by the difference between DM ensiled and DM recovered when the silos were opened after 90 d from ensiled. Effluent losses were quantified by weight difference pipe, after silage removal. Gas losses was quantified by the difference in weight of the whole silo after silage and immediately before opening. Silage samples were collected for pH and buffering capacity expressed as miliequivalent of alkali required to change the pH from 4 to 6 per 100 g of dry matter. Data were analyzed using PROC MIXED of SAS 9.3 including the fixed effects of molasses, microbial inoculant and reproductive growth stages. There were 3 ways interactions for gas losses, where molasses increase ($P < 0.001$) dry matter recovered and reduced ($P < 0.001$) pH without microbial inoculant addition. The molasses decrease ($P < 0.05$) total dry matter losses regardless reproductive growth stage except in R4. Molasses addition decrease ($P < 0.03$) effluent losses in R4, R5, and R6 when associated with microbial inoculant. In general the use of molasses as a fermentative additive improved the quality of soybean silage.

Key Words: dry matter, leguminous silage, additive

T123 Growth rate and biomass accumulation in forage maize (*Zea mays*), forage millet (*Echinochloa utilis*), elephant grass (*Pennisetum purpureum*) and gamba grass (*Andropogon gayanus*). O. M. Makinwa, A. H. Ekeocha*, and A. A. Aganga, *Federal University Oye-Ekiti, Oye-Ekiti, Ekiti State, Nigeria.*

To have higher profits and sustained production of livestock it is important to understand the biomass accumulation (BMA) and growth rate (GR) of the forages the animals feed on. This work looked into the nutrient content at various growth stages and biomass accumulation of forage maize (*Zea mays*), forage millet (*Echinochloa utiliz*), elephant grass (*Pennisetum purpureum*), and gamba grass (*Andropogon gayanus*). Experiment was conducted between July and August at a location within Federal University Oye-Ekit, Ekiti State, Nigeria. Planting was done using completely randomized design (CRD) in 4-rows with 4 replicates. Plot size was 27 × 72 cm. Linear additive model was used to test for the effect of the grass specie and the effect of age of cuting on the final BMA of individual cuttings. Harvest was done biweekly starting from 2 wk after planting until wk 8 of planting when experiment was terminated. Highest growing grass in terms of plant height and sward height was *Pennisetum purpureum* throughout the period of carrying out this experiment. *Zea mays* had significantly higher values in leave width (5.44 cm at 8 wk) and number of leaves (8.67 cm at 8 wk) during the experiment when compared with other grass species $P < 0.05$. At the end of 8 wk; *Zea mays* had the highest BMA of 114%, *Echinochloa utiliz* had a BMA of 51.31%. *Andropogon gayanus* had a BMA of 45.53%, *Pennisetum purpureum* had a BMA of 44.32%. Samples from the last cuttings (wk 8) had the highest CP content (11.88% in *Andropogon gayanus*) although there was no significant differences between the CP levels of the different species statistically $P > 0.05$. Crude protein was found to increase nearly linearly as the grasses grew. Crude fiber content of the 3 grass species was observed to undulate as the grasses grew although there was no significant difference $P > 0.05$ between the species. Crude fiber, moisture content and the fat content all followed the same irregular patterns and there was no significant differences $P > 0.05$ between their percentage compositions in all the plant samples. In conclusion, GR reduces with increasing BMA.

Key Words: *Zea mays, Echinochloa utilis, Pennisetum purpureum*

T124 Effect of nitrogen dose and harvesting age on *Tithonia diversifolia* yield and quality. J. A. Elizondo-Salazar*[1] and M. G. Mora-Mora[2], [1]*Universidad de Costa Rica, Facultad de Ciencias Agroalimentarias. Estación Experimental Alfredo Volio Mata,* [2]*Ministerio de Agricultura y Ganadería.*

Tithonia, commonly known as Mexican sunflower, is a shrub belonging to the Asteraceae family. It is widely distributed throughout the humid and sub humid tropics of Central and South America, Asia and Africa. Tithonia has been shown to be an excellent forage for ruminant nutrition, however few studies have been undertaken to evaluate yiel and nutrional quality for dairy cattle feeding. The objective of this study was to evaluate biomass production and nutritional quality of *Tithonia diversifolia* harvested at 3 different ages and fertilized with 3 N doses. The experiment was carried out in the province of Guanacaste, Costa Rica. A randomized block experimental design was used in a split plot arrangement with 4 replications. N rates (0, 150, and 300 kg/ha/yr) were allocated to the main plots, and harvest times (45, 60 and 75 d of regrowth) were allocated to the subplots. DM yield was affected ($P < 0.05$) by the different variables. Plants receiving 300 kg of N and harvested at 75 d of age, yielded 12.1 tons of DM/ha/yr, while plants receiving 0 kg of N and harvested at 45 d of age produced 4.8 tons of DM/ha/yr. CP concentration was affected by treatments ($P < 0.05$) and values ranged between 10.4 and 25.7%. CP yield was affected ($P < 0.05$) by N rate and harvesting age. Plants fertilized with 300 kg of N and harvested at 75 d of age produced 1.9 tons of CP/ha/yr. NDF and lignin concentration were highest ($P < 0.05$) when plants received 0 kg of N and were harvested at 75 d of age (57.9 and 19.2%, respectively). Ash

content was also affected by treatments ($P < 0.05$) and values ranged from 9.8 to 17.5%. Results suggest that *Tithonia diversifolia* seens to be a promising forage for dairy cattle feeding in Costa Rica with best yields and nutritive quality when using N rates ranging from 150 to 300 kg/ha/yr and a harvesting age of 60 or 75 d.

Key Words: forage, nitrogen rate, dairy cattle feeding

T125 Aerobic stability and ruminal degradation of savoy grass silage (*Megathyrsus maximus*) with increasing levels of passion fruit (*Passiflora edulis*) peel. I. F. E. Guerra*, M. L. M. Villacís, L. B. M. Vivas, A. R. S. Laiño, M. J. R. Romero, E. D. T. Navarrete, L. A. G. Montiel, and M. A. M. Villacis, *Universidad Tecnica Estatal de Quevedo, Quevedo, Los Rios, Ecuador.*

The objective of the present study was to determine the aerobic stability and in situ ruminal dry matter degradation of the silage of savoy grass including increasing levels of passion fruit residue (10, 20, 30, and 40% on fresh basis) in the silage of 45-d-old savoy grass. The silage of the chopped and homogenized products was carried out in experimental microsilage (5 replications per treatment). The data for aerobic stability and ruminal degradability were analyzed with the GLM procedure using the treatment as a fixed effect, and the least squares means were compared with the Tukey test. When the effect studied was time, the linear trend was investigated by orthogonal polynomial contrasts. Additionally, the Dunnet test was carried out, using as a reference the value at 0 h, when the linear effect was significant. Statistical significance was set at $P < 0.05$. After 21 d, the microsilages were opened and the aerobic stability temperature (T) and pH for 6 d and the in situ degradation of the dry matter (DM) at 0; 3; 6; 12; 24; 48 and 72 h (h) were determined. The combination between 10 and 40% of passion fruit residue fresh weight with savoy grass did not have important effects on aerobic stability and ruminal degradation. In all the treatments, a low aerobic stability was observed with an increase in T higher than 1°C at 6 d and more than 0.5 pH units after 2 d. The ruminal degradation of the DM was higher ($P < 0.05$) in silages that included 30 and 40% of passion fruit residue, which would indicate a higher nutritional value. Savoy grass silage with passion fruit residue could be an efficient and environmentally acceptable way to dispose of food to sustain the productivity of bovine herds during the dry season. However, the high aerobic instability must be taken into account when handling silage to avoid material and nutrient losses.

Key Words: residue, passion fruit, degradability

T126 Effect of cellulase and fermentation period on the nutritive value of *Panicum maximum* (cv. Mombasa) silage. P. A. Helrigel, V. L. Banys, M. Dias, L. R. Q. Carvalho, N. P. S. Morais, and E. A. Collao-Saenz*, *Universidade Federal de Goiás-UFG, Jataí, GO, Brazil.*

Although Mombasa grass is used for silage production in the tropics, little is known about the changes caused by the addition of fibrolytic enzymes in the ensiled mass. The objective of this study was to determine the effect of cellulase addition on the chemical composition, fiber digestibility, fermentation characteristics and the storage period of *P. maximum* (cv. Mombasa) silage. The experiment was in a completely randomized, 3 × 3 factorial design with 4 replicates (CELLUCLAST doses: 0, 3, and 6% wt/wt, g cellulase/100g cellulose; fermentation periods - 30, 60 and 120 d). Mombasa grass was cut at an approximate height of 80 cm, at 20 cm from the ground level and ensilaged in 36 PVC mini-silos of 4-L capacity. Fermentation of soluble carbohydrates released by cellulose hydrolysis promoted pH and titratable acidity adequacy, demonstrating that there was a higher VFA production and lactic acid favoring the desirable forage fermentation, reducing the DM loss and improving the nutritive value of the silage. NDF was reduced linearly and TDN increased up to 13.8% (Table 1). Cell wall degradation by cellulase during ensiling decreased NDFD by 10.53%, less than the increase in TDN, indicating that the fibrolytic enzyme addition improved the nutritive value and stability of *P. maximum* silages. Mass and nutrient losses (13.8% DM, 8.8% CP) observed in the longer period may indicate that the best storage time is up to 60 d. Enzyme addition was efficient to improve the fermentative and bromatological parameters.

Table 1 (Abstr. T126). Effect of cellulase adding and fermentation period on *P. maximum* silage nutritive value

Variable and fermentation period	Cellulase dose (%)[1]			Effect[1]		
	0	3	6	L	Q	SEM
NDF						
30 d	77.3[a]	72.3[a]	72.1[a]	<0.01	0.1	0.80
60 d	77.7[a]	74.6[a]	65.3[b]			
120 d	74.1[a]	68.7[b]	67.5[b]			
TDN						
30 d	52.6[a]	56.6[a]	55.7[a]	<0.01	0.03	0.56
60 d	52.4[a]	54.5[a]	60.8[a]			
120 d	54.8[a]	58.5[a]	59.3[a]			
DM, % NM	22.8	24.6	24.8	<0.01	<0.01	0.12
ADF, % DM	46.3	42.7	43.0	<0.01	<0.01	0.66
NDFD, %	36.2	32.4	35.2	0.50	0.01	1.01
pH	4.7	3.8	3.6	<0.01	<0.01	0.04
Titratable acidity, °D	5.9	12.4	13.2	<0.01	<0.01	0.28

[a,b]Means followed by the same letter, in a column, do not differ by Tukey test ($P < 0.05$).

[1]L = linear; Q = quadratic.

Key Words: fibrolytic enzyme, TDN, titratable acidity