FORAGES AND PASTURES III: GENERAL FORAGES AND FORAGE SYSTEMS

1104 (W091) Effect of plant density on nutritional quality of green chopped corn. G. Ferreira[*1,2], D. Carp[2], M. Alfonso[3], and S. Depino[3], [1]Dep. of Dairy Science, Virginia Polytechnic Institute and State University, Blacksburg, [2]CREA Lincoln, Asociación Argentina de Consorcios Regionales de Experimentación Agropecuaria, Lincoln, Buenos Aires, [3]*Forratec Argentina, SA, Chacabuco, Buenos Aires.*

The hypothesis of this study was that seeding corn at high plant densities results in greater concentrations of neutral detergent fiber (NDF) and lower concentrations of starch in corn whole plant. Therefore, the objective of this study was to determine the effect of planting density on whole-plant dry matter (DM) yield and its nutritional quality. The study was performed in a commercial dairy farm located in General Villegas, Argentina. Preceding crop was corn for silage. Total rainfalls during fallow and crop season were 719 mm. Two commercial corn hybrids (Dekalb747 and Duo548) were sown at 60,000, 70,000, 80,000 and 90,000 plants/ha^{-1} in four plots using a no-till corn seeder with a pneumatic dosing machine (TX Mega, Agrometal, Argentina). Plots were composed of eight 50-m rows separated by 52 cm. Corn was sown on October 13, 2012 and chopped on February 1, 2013. Crop was fertilized with 90 kg N and 31 kg P2O5 per hectare. Ten consecutive corn plants, randomly selected from each plot, were manually cut at 15 cm above ground, chopped with a forage chopper (TRF 70, Trapp, Brasil) and weighted to determine DM yield. Nutritional quality of chopped corn was determined by NIRS. Because the resulting densities were inferior and more variable than targeted (likely due to soil temperature variation linked to no-till conditions) statistical analysis was performed by linear regression. Average DM concentration of the chopped corn was 31.1 and 34.5% for the Duo548 and Dekalb747 hybrids, respectively. Plant density did not affect whole plant dry weight ($P > 0.51$) in either hybrid (285 and 252 g DM.plant^{-1} for Duo548 and Dekalb747, respectively). Therefore, DM yield was linearly increased with plant density (slope = 237 kg DM.1000 plants^{-1}.ha^{-1}, $P < 0.01$). Contrary to the hypothesis, plant density did not affect either NDF concentration ($P > 0.25$) nor starch concentration ($P > 0.72$) of chopped corn (47.2 and 50.2% NDF and 27.5 and 21.3% starch for Dekalb747 and Duo548, respectively). Estimated DM digestibility was not affected ($P > 0.24$) by plant density in either hybrid (65.5 and 67.2% for Duo548 and Dekalb747, respectively). We concluded that, with abundant rainfalls (i.e., >700 mm), plant density does not affect nutritional quality of corn. Whether plant density affects nutritional quality of corn under lower rainfall regimes still needs to be elucidated.

Key Words: corn, density, quality

1105 (W092) Assessment of in vitro fermentation characteristics of lactation dairy diets consisting of orchardgrass or birdsfoot trefoil pasture forages with different supplements using continuous cultures. R. G. Christensen[1], A. J. Young[1], J. S. Eun[*1], J. W. MacAdam[1], and B. R. Min[2], [1]*Utah State University, Logan,* [2]*Tuskegee University, Tuskegee, AL*

This study evaluated the effects of feeding 2 different pasture forages [orchardgrass (OG) vs. birdsfoot trefoil (BFT)] combined with 3 supplements [no supplement, ground barley (GB), and forage-concentrate mixture (FCMX)] on in vitro fermentation characteristics. The experiment was performed in a 2 (source of pasture forage) × 3 (supplement) factorial design with 3 independent runs of continuous cultures ($n = 3$). Continuous culture apparatus consisted of 700-mL working volume fermentation vessels to measure major fermentation end-products. Each culture was offered a diet of 15 g DM/d in 4 equal portions at 0600, 1200, 1800, and 2400 h, and the supplements (GB and FCMX) were included at 30% DM of total diets. Culture pH averaged 6.15 and was not different across treatments. Total VFA concentration averaged 39.5 m*M* and did not differ among treatments. Feeding different pasture forages did not influence acetate and propionate concentrations. While acetate concentration was similar across treatments, propionate concentration increased with supplementing GB or FCMX, resulting in a decreased acetate-to-propionate ratio due to the supplementations. Ammonia-N concentration tended to decrease ($P < 0.06$) with BFT compared with OG (9.40 vs. 13.5 mg/100 mL), whereas supplementation resulted in no difference in the ammonia-N concentration, regardless of source of pasture forage. Methane production decreased when fermentors were offered BFT compared with OG (8.50 vs. 10.9 mmol/d), but supplementation did not affect the methane production under OG as well as BFT. The positive impacts of feeding BFT pasture forage with decreased ammonia-N and methane concentrations could have resulted from beneficial effects of condensed tannins (4.46% DM) in BFT which manipulate ruminal fermentation pathways by improving utilization of N and energy substrates. Overall results in this experiment indicate that feeding BFT-based dairy diets did not interfere with in vitro ruminal fermentation, and BFT can be an effective forage source to reduce N excretion and mitigate methane emissions.

Key Words: birdsfoot trefoil, condensed tannins, continuous cultures

1106 (W093) Fatty acid profile and oxidative stability of carcass fat from meat goats fed grass-legume forage diets. B. R. Min[*], *Tuskegee University, Tuskegee, AL*

A series of experiment was conducted at the Caprine Research and Education Unit at Tuskegee University to develop and

demonstrate a profitable and sustainable forage-based goat production system with 6 different forage combinations included annual ryegrass (RG) or RG + legume combinations (e.g. Austrian pea (AP), berseem clover (BC), hairy vetch (HV), RG+AP+HV, and RG+HV+AP+BC)) in the winter of 2011 for the Southeastern United States. Forty-eight crossbred goats (*Capra hircus*; BW= 27.46 kg) were randomly assigned to 12 paddocks with 6 forage combinations with 2 replicates *(n* = 4) during 45 days. After grazing ended, goats were transported to Mississippi State University Meat Lab and were slaughtered according to the USDA guidelines and carcass characteristics were determined. Forage biomass and forage chemical composition were measured from February to May. On each occasion four random quadrates (0.25 m^2) per forage paddock were cut using a hand-clipper. There was a forage sampling time x forage combination interaction ($P < 0.01$) for CP and NDF. Forage CP content was higher in March than February and April, but NDF content continuously increased with time. The RW with HV combinations continued to have greater CP content. Animals on RG and BC combinations grew 18% faster and reached expected slaughter weight in less time when compared to RG pasture system. Goats grazing RG+BC and RG+HV+AP had higher ($P < 0.05$) ADG and carcass weights than other forage combinations. Goats grazed on RG-based diet had higher SFA and polyunsaturated fatty acids (PUFA) in intramuscular fats ($P < 0.01$), but were lower in mescenteric kidney fat and subcutaneous fat ($P < 0.05$) compared to legume forage-based diets, respectively. For goats grazing on RG-based diet had significantly higher ($P < 0.05$) omega-3 and omega-6 fatty acids in intramuscular fat content, but were lower in subcutaneous fat ($P < 0.05$) compared to legume forage-based diets. Mono unsaturated fatty acids (MFA) were not affected by diets. These results indicated that goats receiving RG forage-based diets produced carcasses with more PUFA and higher omega-3 and -6 fatty acids in intramuscular fat from Kiko-crossbred male goats.

Key Words: fatty acids, goats, grass, legume

1107 (W094) Effects of moisture level at baling and Fresh Cut brand plus on quantity and quality of alfalfa hay harvested in large rectangular bales. K. E. Griswold*, R. Almada, A. Lipata, and E. Rodberg, *Kemin Animal Nutrition & Health, Des Moines, IA.*

The effects of baling moisture and Fresh Cut brand plus (Kemin Industries, Des Moines, IA), a propionic acid-based preservative, on quantity and quality of alfalfa hay harvested in large rectangular bales were determined in a split plot design. Baling moisture, low (LM, <15%) vs. high (HM, >20%), was the main plot, and control (NT) vs. Fresh Cut Plus (FC+) applied at recommended levels was the subplot. Weight, mold and yeast counts, and nutrient content were determined for fresh (day of baling) and cured (8 wk after baling) bales using composite samples from 6 cores per bale. Data were analyzed using JMP software with models that included the fixed effects of baling moisture, FC+, and the interaction of moisture by FC+. Significance equaled $P < 0.05$ and trends equaled $0.05 < P < 0.10$. Mold and yeast counts were log transformed prior to analysis. Data are presented on DM basis. The interaction of HM baling and FC+ increased ($P < 0.01$) fresh bale weights (709 vs. 644 kg, respectively) and tended ($P = 0.06$) to increase cured bale weights (719 vs. 635 kg, respectively) compared to all other treatments. In cured bales, mold and yeast counts were lower (4.5 vs. 5.4 and 5.1 vs. 5.8, respectively; $P < 0.01$) for HM vs. LM bales. In fresh bales, mold and yeast counts were not affected ($P > 0.10$) by FC+, but were lower (4.7 vs. 5.2 and 5.3 vs. 5.7, respectively; $P < 0.05$) in cured bales compared to NT. There were no effects or interactions ($P > 0.10$) of baling moisture and FC+ on nutrient content of fresh bales. In cured bales, the baling moisture and FC+ interacted to lower ($P < 0.05$) sugar content (4.62 vs. 6.09%, respectively) and concomitantly increase ($P < 0.05$) lignin (5.42 vs 4.59%), ADICP (2.73 vs. 2.41%), and fat (1.77 vs. 1.66%) content, respectively. In cured bales, FC+ lowered ($P < 0.05$) CP (25.2 vs. 25.7%) compared to NT, and HM baling increased ($P < 0.05$) ADF (29.4 vs. 28.1%), NDF (38.4 vs 36.8%), and ash (14.1 vs. 13.6%) content compared to LM, respectively. However, there were no significant ($P > 0.05$) effects of treatments on feeding value of fresh or cured alfalfa as determined by MILK 2006 software. Overall, these results would suggest that baling at high moisture in combination with FC+ treatment allowed for the harvesting and retention of more high quality alfalfa DM in large rectangular bales compared to baling at low moisture with or without FC+ application.

Key Words: alfalfa, moisture, Fresh Cut plus

1108 (W095) Estimation of macronutrients content in mixed swards by near infrared reflectance spectroscopy. A. I. Roca-Fernández*, P. Castro-García, and A. González-Rodríguez, *Agrarian Research Centre of Mabegondo, La Coruña, Spain.*

Near infrared reflectance spectroscopy (NIRS) is a rapid, non-destructive and inexpensive technique for providing chemical analysis of forage and feedstuffs. The aim of this study was to develop NIRS calibration equations to determine macronutrients (P, Ca, Mg and K) content in mixed swards. Two hundred twenty samples were taken from mixed ryegrass (*Lolium perenne* L. and *Lolium multiflorum* Lam.) and clover (*Trifolium repens* L. and *Trifolium pratense* L.) swards located in a grassland area from Galicia (NW Spain). Reference data that were used for developing calibration equations were analyzed using standard laboratory methods widely applied for determination of macronutrients content in swards samples (*P* was measured colorimetrically as molybdovanado-phosphoric acid and Ca, Mg and K were measured by atomic absorption spectrophotometry). All the samples were scanned with monochro-

matic radiation from 1100 to 2500 nm using NIRSystems 6500 (FOSS Analytical AS, Denmark). Predictive equations were developed using modified partial least squares (MPLS) regression with internal cross-validation and scatter correction using standard normal variate (SNV) and detrend. Cross validation was used to avoid overfitting of the equations. The best equations of MPLS regression for the four macronutrients were obtained by using the second derivative of spectra than using the first derivate. The coefficient of determination in calibration (R^2_c), cross validation (R^2_{cv}) and prediction (R^2_p) and the standard error of calibration (SE_C), cross validation (SE_{CV}) and prediction (SE_P) found for each macronutrient were: P (R^2_c= 0.72 and SE_C= 0.43; R^2_{cv}= 0.61 and SE_{CV}= 0.51; $R^2_{P=}$ 0.70 and $SE_{P=}$ 0.46), Ca (R^2_c= 0.90 and SE_C= 1.44; R^2_{cv}= 0.69 and SE_{CV}= 2.50; $R^2_{P=}$ 0.84 and $SE_{P=}$ 1.35), Mg (R^2_c= 0.76 and SE_C= 0.19; R^2_{cv}= 0.58 and SE_{CV}= 0.26; $R^2_{P=}$ 0.60 and $SE_{P=}$ 0.20) and K (R^2_c= 0.82 and SE_C= 3.46; R^2_{cv}= 0.71 and SE_{CV}= 4.37; $R^2_{P=}$ 0.74 and $SE_{P=}$ 2.98). Taking into account RPD values for validation, calculated as standard deviation of reference data (SD) divided by SE_P, a good quantitative prediction of Ca (RPD= 2.27) and approximately of P, Mg and K (RPD= 1.79, 1.66 and 1.95, respectively) were achieved. Nevertheless, these results might be improved by adding samples to the calibration set.

Key Words: minerals, NIRS, ryegrass-clover pastures.

1109 (W096) Fall harvest management of eastern gamagrass. W. K. Coblentz*[1], M. G. Bertram[2], P. C. Hoffman[3], N. M. Esser[4], and J. S. Cavadini[4], *[1]U.S. Dairy Forage Research Center, Marshfield, WI, [2]University of Wisconsin, Arlington, [3]University of Wisconsin, Madison, [4]University of Wisconsin, Marshfield.*

Recent research has suggested that eastern gamagrass (EGG) may be an effective alternative to chopped straw in the blended diets of dairy heifers and cows. Most extension materials discussing appropriate fall management of EGG recommend avoiding harvest within about 6 weeks of first frost. Using this guideline for central Wisconsin, a final harvest of EGG would need to occur before August 15; however, previous research has shown that single-harvest yields of DM are not maximized by that date because of inadequate accumulation of growing degree days. Our objectives were to evaluate yields of DM, plant persistence, and nutritive value for EGG harvested at 15-d intervals between August 1 and November 1. Residual forage growth was burned each May, and all forages were fertilized with 84 kg N/ha annually. Data collected from 2010 through 2013 indicated that yields of DM increased with linear ($P < 0.01$) and quadratic ($P < 0.01$) effects over harvest dates, peaking at > 7400 kg/ha on both the September 15 and October 1 harvest dates. Overall DM yields varied with year, but were greatest ($P < 0.01$) during the final year (2013) of the trial (7967 kg/ha), thereby suggesting stands were not damaged by fall harvests. Percentage of continuous row coverage also was assessed, but was not affected by harvest date ($P \geq 0.22$). Concentrations of NDF increased from 75.8 to 82.0% across harvest dates, exhibiting both linear and quadratic ($P < 0.01$) effects. Similarly, acid-detergent lignin increased from 4.07 to 5.12% between August 1 and November 1, exhibiting only a linear ($P < 0.01$) effect of harvest date. Crude protein declined linearly ($P < 0.01$) across harvest dates, ranging from 7.69 to 3.67%. Energy density also declined linearly ($P < 0.01$) over harvest dates, ranging from 53.2% TDN on August 1 down to 43.9% TDN on November 1. One-time harvests of EGG during fall allowed for improved yields of DM through October 1, and did not affect stand persistence. For harvests timed between August 1 and November 1, EGG will likely range between 75.0 and 82.0% NDF, and exhibit an energy density of approximately 50% TDN. These characteristics, coupled with the consistent observation that EGG haylage is not sortable by dairy heifers or cows, make EGG a potentially attractive alternative to chopped straw.

Key Words: eastern gamagrass, fall harvest management, DM yield

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1110 (W097) Fertilization of fall-grown oat with urea or bedded-pack manure. W. K. Coblentz*[1], W. E. Jokela[1], and M. G. Bertram[2], *[1]U.S. Dairy Forage Research Center, Marshfield, WI, [2]University of Wisconsin, Arlington.*

Oat (*Avena sativa* L.) shows promise as a fall-forage option for dairy producers in Wisconsin, and potentially opens a window of opportunity for manure spreading that is not associated with production of corn (*Zea mays* L.). Our objectives were to assess the effects of summer applications of commercial N fertilizer or bedded-pack manure containing wood shavings on the DM yield, N uptake and recovery, and nutritive value of fall-grown oat forages. Research plots were fertilized with either bedded-pack manure (23 or 45 Mg/ha, wet basis; 22.9% DM; 1.9% N, DM basis) or urea (46-0-0) at application rates of 0, 20, 40, 60, or 80 kg N/ha, and then seeded to two oat cultivars (Ogle or ForagePlus). Plots were harvested on two dates (early October or November), which simulated grazing and silage applications, respectively. Climatic conditions differed sharply across years, with growth responses limited somewhat by drought during 2012. During both years, DM yield increased linearly ($P \leq 0.03$) with commercial N fertilization, and yields following applications of urea exceeded ($P < 0.01$) forages receiving bedded-pack manure during 2011, but not during 2012 ($P = 0.85$). Overall DM yields were greater in early November compared to early October during both 2011 (3991 vs. 2257 kg/ha; $P < 0.01$) and 2012 (2753 vs. 1997 kg/ha; $P < 0.01$). Apparent percentage N recoveries by oat forages increased linearly ($P = 0.01$) with urea application rate during 2011, and increased with both linear ($P = 0.01$) and quadratic ($P < 0.01$) effects during 2012. However, apparent N recoveries following applications of bedded-pack manures were es-

sentially nil for both years (overall range = -6.2 to 2.6% of N applied). For 2011, concentrations of water-soluble carbohydrates (WSC) were inversely related to urea application rate, declining from 12.4 to 10.1% as fertilization rate increased from 0 to 80 kg N/ha, which was explained by both linear (P = 0.01) and quadratic (P <0.01) effects of application rate. Similar effects were observed for 2012, when WSC declined from 19.3 to 16.3% across the same urea fertilization treatments. Calculated energy density of fall-oat forages remained very high across all treatments; overall means were 67.0 and 70.1% TDN for 2011 and 2012, respectively. These results indicate that fall-grown oat is an energy-dense forage option, but bedded-pack manures containing wooden shavings provide little immediately available N to support forage production.

Key Words: bedded-pack manure, fall-grown oat, N fertilization

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1111 (W098) Nutrient composition and in vitro digestibility of cultivated and non-cultivated plant species found within a Southwestern forage production operation. J. D. Allen[*1], L. W. Hall[2], and J. English[2], *[1]Northwest Missouri State, Maryville, [2]University of Arizona, Tucson.*

Nutrient quality of non-cultivated plants in hay or grazing pasture may affect animal feeding behavior, digestive efficiency, forage quality, or a combination of these. Understanding nutritive composition of invasive plants may improve forage and weed management. A 2-year study was conducted to determine the nutrient composition and digestibility of invasive plants growing within the boundaries of 3 alfalfa hay fields and 7 grass pastures (9.75 ha) located at the University of Arizona's West Agriculture Campus and Campus Agricultural Center (Tucson). Multiple whole above-ground samples of cultivated and non-cultivated species were collected at a maturity of mid-bloom for non-grasses (n = 53) and pre-shatter for grasses (n = 13). Samples were analyzed for DM, ash, NDF, ADF, ADL, CP, and IVTD. Species from 21 plant families were sampled, with the grass (*Poaceae*) family having the highest specie count (13), and 9 forb families having only 1 specie recorded. Compared to cultivated alfalfa, forb species had greater (P < 0.01) CP (20.2 vs. 15.5 ± 2.85%), ADL (8.5 vs. 3.0 ± 1.74%), and IVTD (75.1 vs. 67.3 ± 3.28%), and grass species had greater (P < 0.01) NDF (53.8 vs. 45.9 ± 3.76%) but lower (P < 0.01) ADF (25.7 vs. 33.6 ± 1.74%). Seven (7) plant families were represented by at least 3 species: amaranth (*Amaranthaceae*; n = 3), sunflower (*Asteraceae*; n = 7), mustard (*Brassicaceae*; n = 7), goosefoot (*Chenopodiaceae*; n = 5), knotweed (*Polygonaceae*; n = 4), nightshade (*Solanaceae*; n = 5), and grass. Within the 7 families, grasses had greatest NDF but least ADL, ash, and IVTD (54.7, 5.7, 11.9, and 64.3%, respectively; P < 0.01). Nightshade species had greatest CP (23.5%; P < 0.01), amaranth species had greatest IVTD and least NDF (84.0 and 29.3%, respectively; P < 0.01), and mustard species had greatest ADL (10.1%; P < 0.01). Greatest variation was observed with DM (SEM range = 2.47 to 16.98%), and least variation was observed with ADL (SEM range = 0.93 to 4.33%). Predominant species observed affecting grazing behavior or hay production included junglerice (*Echinochloa colonum*), bermudagrass (*Cynodon dactylon*), little mallow (*Malva parviflora*), and Palmer amaranth (*Amaranthus palmerii*). Results indicate the presence of non-cultivated plants growing within Southwestern hay and grazing fields may affect forage nutritive quality.

Key Words: forage, in vitro, invasive plants, nutrient composition

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1112 (W099) Effects of Marandu pastures heights and sources of energy supplements on the weights gains per animal and per area. A. A. Oliveira[1], M. V. Azenha[*2], S. S. Santana[2], C. H. O. Macedo[2], J. P. R. Costa[2], T. T. Berchielli[2], A. C. Ruggieri[3], and R. A. Reis[2], *[1]Unesp, Jaboticabal, Brazil, [2]University of Sao Paulo State, Jaboticabal, Brazil, [3]Sao Paulo State University, Jaboticabal, Brazil.*

The study aimed to evaluate forage allowance based in sward heights, and energy supplementation from different sources in the weight gain of young Nellore bull yearling in pastures of *Urochloa brizantha* cv. Marandu. Grazing system was continuous with variable stocking (put and take animals) to maintain the sward height during the rainy season. Three pasture heights (15, 25, 35 cm) were combined with three supplementation strategies (mineral mixture, protein/energy supplement based in corn meal, and protein/energy supplement based citrus pulp) distributed in eighteen paddocks (two pasture replications). Both energy/protein supplements contained 19.0% of crude protein, and were supplied at 0.3% of body weight/day. Experiment was conducted from January to April. Forage mass, and animal body weight were determined monthly to calculate the forage allowance. One hundred eight animals (259 ± 20 kg) were grazed for 122 d and weighed at the beginning and the end of the trial. Total dry matter intake was evaluated using modified lignin LIPE (eternal marker), and indigestible neutral detergent fiber (internal marker). The type of supplementation did not influence (P > 0.05) any pasture variable evaluated during the experimental period. To maintain pastures heights it was necessary to adjust the stocking rate that decreased linearly (6.64, 5.03 and 4.08 UA/ha^{-1}) in response to the treatments (15, 25 and 35 cm, respectively). Forage allowance, and dry matter intake increased linearly (P < 0.05) in response to the pasture heights, or forage allowance. Gain per unit of land showed a quadratic response associated to lowest weight gains per unit of land (6.94, 6.38, and 5.37 kg/ha/day) in response to pasture heights (forage allowance), but there was a positive response in individual animal weight gain (0.694, 0.874 and 0.953 kg/day). Protein/energy supplementation increased (P < 0.05) weight gain per area and per

animal. Citrus pulp provided greater ($P < 0.05$) stocking rates (5.4 AU/ha), but corn was similar (5.3 AU/ha) to both mineral (5.0 AU/ha) and citrus pulp. Pasture management at 15 cm during the rainy season resulted in highest stocking rate, and consequently more weight gain per area. However, lowest forage allowance reduced forage intake, average daily weight gain, and final body weight at the end of the rainy season. It was concluded that the pasture energy/protein supplementation (0.3% BW) provides a balance between gain per area, per animal, and low risks to pasture degradation and maximum productivity in the system.

Key Words: beef cattle, supplementation, weight gain

1113 (W100) Effect of sowing date on forage yields and quality of Italian ryegrass in early spring-seeded. K. Kim*, *Livestock Institute, Jeollanamdo, South Korea.*

Because Italian ryegrass (IRG) is generally cultivated by winter cropping on a drained paddy field, the harvest season is overlapped with that of rice in some cases. In addition, people may miss the adequate seedtime for IRG because of the rainy season. Therefore, this research has been performed between October 2012 and July 2013 in Kangjin, Korea, to examine the effect of spring-seeding on the yields and quality of IRG, as an alternative seeding when the adequate seedtime is missed. Using Kowinearly species, five test groups were prepared depending on the sowing date: Control group (sowing date: October 20, 2012, which is an optimum seeding-time), T1 (sowing date: February 15, 2013), T2 (sowing date: February 25, 2013), T3 (sowing date: March 5, 2013) and T4 (sowing date: March 15, 2013), and the IRG was harvested in May 31, 2013. The lodging of vegetative period for control group, T1 and T2 was >70%, while that of T3 and T4 was approximately 50%. The plant height by harvesting for control group showed the highest value of 109.5cm, and for T1 and T2 was 102.2 and 103.0cm, while those for T3 and T4 were 98.6 and 93.3cm, respectively, whereby the difference was statistically significant ($P < 0.05$). The fresh yield per ha was 38.0, 26.5, 21.2, 22.3 and 20.4 ton/ha for control group, T1, T2, T3 and T4, respectively, where the control group showed the highest value and the T1 was significantly larger than those for T2~T4 ($P < 0.05$). The yield for dry matter was 31.3, 27.8, 28.8, 24.4 and 22.3% for the control group, T1, T2, T3 and T4, respectively, which is the similar to the fresh yield. On the other hand, the content of crude protein was 7.9, 8.6, 8.7, 9.4 and 12.3% for the control group, T1, T2, T3 and T4, respectively, where a shorter growing period represents the higher crude protein content. The ADF was 36% for the control group and T1 ~ T3, while that for T4 decreased to 33%. The NDF was 66% for the control group and T1 ~ T3, while that for T4 decreased to 61%. According to these findings, it can be summarized that the Spring-seeding of IRG gives <70% yield compared to that by the adequate seeding. However, the optimum seeding time to maximize the forage yield and quality would be before February 25.

Key Words: Italian ryegrass, early spring-seeded, forage yield, forage quality

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1114 (W101) Relationship between protein structural characteristics and supply of metabolizable protein to dairy cattle from new cool-season forage corn varieties in Western Canada . *N. A. Khan, S. Abeysekara, D. A. Christensen, X. Huang*, and P. Yu, University of Saskatchewan, Saskatoon, Canada.*

The objective of this study was to find out the relationship between protein inherent molecular structural characteristics of cool-season forage corn and supply of metabolizable protein (MP) to dairy cattle. Six new corn cultivars, including 3 Pioneer (PNR) and 3 Hyland (HL), coded as PNR-7443R, PNR-P7213R, PNR-7535R, HL-SR06, HL-SR22, HL-BAXXOS-RR, were sown in 24 plots on in the research fields of Canada-Saskatchewan Irrigation Diversification Centre (Outlook, SK, Canada). The 24 plots were blocked within 4 fields, and all cultivars were sown in each field (4 block x6 varieties). Whole crop samples were collected after a target of 2160 CHU was achieved. The MP supply to dairy cattle, and energy synchronization properties were modeled by the DVE/OEB system and the NRC-2001 model. The parameters evaluated were protein molecular structures in terms of amide I, amide II, amide I to II ratio, α-helix, β-sheet and α-helix to β-sheet ratio, which were determined using vibrational molecular spectroscopy (VMS). The data analysis were performed using SAS with Proc Mixed and Proc Corr. The Normality test was used Proc Univariate with Normal and Plot options. Multivariate molecular spectral analyses were performed with Statistica (StatSoft Inc., Tulsa, OK). The Tukey method was used for multi-treatment comparison. The significant level was declared at $P < 0.05$. There were no significant differences ($P > 0.05$) among the cultivars in molecular-spectral intensities of protein molecular structures. The amide II had a significant positive correlation with truly absorbable rumen undegraded feed protein (ARUP) ($r = 0.30$; $P < 0.001$), and had a significant negative correlation ($r = 0.18$, $P < 0.05$) with truly absorbable endogenous CP (AECP). Whereas, both amide I and amide II, and protein secondary structures (α-helix and β-sheet) were inversely correlated with rumen available N per insoluble rumen available OM ($r = \sim -0.30$; $P < 0.001$). In summary, protein molecular structure in the new cool-season corn varieties significantly link to the supply of metabolizable protein to dairy cattle.

Key Words: corn varieties, supply of metabolizable protein, protein molecular structures

1115 (W102) Evaluation of agronomic characteristics of five varieties of corn in integrated crop-livestock-forest system. A. A. Pinheiro*, M. C. A. Santana, V. A. Silva, J. T. C. Pacheco, A. C. Fernandes, and I. D. Carneiro, *Emater, Goiânia, Brazil.*

This research aimend to evaluate the agronomic characteristics of five cultivars of maize intercropped with *Brachiaria brizantha*cv, Marandu. The experimental design was a randomized block with three replications and five treatments. Maize cultivars used were: EMGOPA 501, AL Bandeirantes, BRS Caimbé, PL 6880, BRS 1060. To assess the agronomic characteristics were estimated: plant height, ear height, ear number per plant and number of plants per meter. Corn EMGOPA 501 showed higher plant height, since the height of the spike was equal to cultivars EMGOPA 501 and PL 6880. The number of spike was higher in cultivars EMGOPA 501, Al Bandeirantes and BRS 1060. BRS 1060 showed fewer plants per linear meter. Considering the whole plant corn, all cultivars showed agronomic traits suitable for silage production, highlighting the variety EMGOPA 501 for plant height and ear height hence.

Key Words: silage, ear, production

Table 1115. Means of agronomic characteristics of five cultivars of maize intercropped with *Brachiaria brizantha* cv. Marandu

	EMGOPA 501	AL Bandeirantes	BRS Caimbé	PL 6880	BRS 1060	CV (%)
Plant height	2.88^{A}	2.48^{B}	1.74^{D}	2.56^{B}	2.04^{C}	7.75
Ear height	1.80^{A}	1.39^{BC}	0.89^{D}	1.56^{AB}	1.18^{C}	12.28
Ear per plant	1.12^{AB}	1.25^{AB}	1.00^{B}	1.00^{B}	1.60^{A}	30.15
Plant per meter	3.87^{A}	3.32^{AB}	3.73^{AB}	3.87^{A}	3.20^{B}	13.53

Letters in rows differ ($P < 0.05$).

1116 (W103) Non-structural carbohydrates in Marandu-grass pastures under different grazing intensities. M. V. Azenha*[1], L. F. Brito[1], A. A. Oliveira[1], E. R. Januscksiewicz[1], E. Raposo[1], S. S. Santana[1], R. A. Reis[1], and A. C. Ruggieri[2], *[1]University of Sao Paulo State, Jaboticabal, Brazil, [2]Sao Paulo State University, Jaboticabal, Brazil.*

Carbohydrates are the source of available energy for growth and plants survival. This concentration is reduced by occurrence of defoliation and subsequent regrowth. Thus, reduction being directly proportional to the intensity and frequency of defoliation. This study aimed to evaluate non-structural carbohydrate content on Marandu-grass pasture managed under three grazing management heights. The heights of 15, 25 and 35 cm were managed by beef steers grazing under continuous stocking. Evaluations of non-structural carbohydrates occurred from January to November, 2011, at the UNESP, Jaboticabal, SP. Data were analyzed by repeated measurements with grazing intensity, period and interaction as sources of variation in variance analysis using proc mixed from SAS. Root and shoot samples were collected monthly with a steel cylinder of 15 cm diameter and 13.7 cm high. The collected samples were washed and processed for further analysis. The non-structural carbohydrates content in shoots was not affected ($P > 0.05$) by grazing heights, season and interaction grazing height and seasons of the year. In roots, the contents were affected by the seasons and the interaction heights and seasons of the year. Concentrations in roots were lower in summer compared to other seasons evaluated. There was linear fit ($P < 0.05$) of grazing heights only in the autumn. Non-structural carbohydrates showed a linear response ($P < 0.05$) and the highest average values observed for the levels of non-structural carbohydrates in the roots occurred in winter (158.61 g.kg^{-1}), followed by those for autumn (114.13 g.kg^{-1}), spring (101.00 g.kg^{-1}), and finally the lowest place in the summer (47.30 g.kg^{-1}). The decrease of values from winter to spring and summer was probably due to the improvement of weather conditions over the spring and summer months, which should have provided higher dry matter accumulation, which, in turn, demanded more organic reserves supply in order to have formed new tissue. Climatic changes conditions, defined by the seasons, provide changes in the levels of non -structural carbohydrates. Marandu-grass pastures grazed to 15 cm did not show a drastic condition management since it does not affect the reserve compounds from plants, when compared with the other hights studied.

Key Words: reserve compound, roots, shoots.

1117 (W104) Production and quality of alfalfa harvested on different stages of maturity in summer and fall. C. Arzola-Alvarez*[1], R. Copado-Garcia[2], O. Ruiz-Barrera[1], C. Rodriguez-Muela[1], A. Corral-Luna[1], A. Castañeda-Correa[1], H. M. Gaytan-Torres[1], and D. Diaz-Plascencia[1], *[1]Universidad Autónoma de Chihuahua, México, [2]Universidad Autonoma de Nuevo Leon, Monterrey, México.*

Alfalfa is a very important forage for the dairy industry. The objective of this study was to determine the effect of maturity on quality of hay of two varieties of alfalfa ("Cuff-101" and "Excellent Multileaf") in two seasons (summer and fall). The production (t/ha) and quality of forage was characterized through the determination of leaf:stem ratio of biomass and its content of dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF) and lignin over a range of days to harvest (0, 5, 10, 15, and 20 d following Stage 2) within the two seasons. Data were analyzed as a split-plot experiment, the plots arranged factorially in a randomized complete block design, being the alfalfa varieties and season the main effects, and maturity the subplot term. Results indicated season influenced both production and forage quality, so in fall the production of DM was lower ($P < 0.05$). On d 20 in summer a yield of 5.8 t MS/ha was determined and in fall only

4.9 t MS/ha, without differences among varieties ($P > 0.05$). Dry matter crude protein (CP) content of leaves in fall was 35.0% on d 0, and in summer 29.3% ($P < 0.01$). In summer, CP content of leaves was 32.7% and 29.3% in the whole plant, without differences among them ($P > 0.05$), whereas the content of CP on stem was lower than both (22.6%, $P < 0.01$). On d 20 in summer the leaves had 25.4% CP, stems 20.2% and whole plant 23.7% in Excellent Multileaf, compared to 23.5%, 19.1% and 21.6% CP in Cuff-101, respectively, without those differences among varieties being significant ($P > 0.05$). On d 20 it was determined 23.7% CP in fall, whereas in summer 21.6% ($P < 0.01$). NDF and ADF diminished ($P < 0.01$) in fall. In terms of CP, ADF and NDF in leaves, stem and whole plant, it was concluded that a higher quality alfalfa was growth in fall, without differences among varieties.

Key Words: alfalfa, CP, fiber

1118 (W105) Effect of cultivars and planting dates on bioenergy feedstock characteristics of switchgrass (*Panicumvirgatum*) in South Korea.

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The objective of this study was to determine the best performing switchgrass (*Panicum virgatum*) cultivar under three different planting dates as a bioenergy feedstock source in South Korea. Height, yield, energy content and chemical composition of three switchgrass cultivars, Carthage (CT), Cave-in-Rock (CIR) and Forestburg (FB) were measured from 2009 to 2012. Plots were seeded on April 23, May 4, and May 13, 2009 and were harvested once in November each year. The experimental design applied was randomized complete block (RCBD) in factorial arrangement with three replications. Planting date at three levels and cultivars at three levels were used as experimental treatments. Samples were analyzed for dry matter (DM), crude protein (CP), neutral detergent fiber (NDF), acid detergent fiber (ADF), crude fiber (CF), ether extract (EE), ash and total digestible nutrients (TDN). Planting dates did not significantly affect characteristics of CT, CIR and FB cultivars ($P > 0.05$). The NDF value of CT, CIR and FB were 81.19, 81.40 and 80.81% (DM basis), respectively ($P = 0.9318$). Also the ADF value was 45.24, 45.99 and 48.99% (DM basis; $P = 0.3558$) for CT, CIR and FB, respectively. Total dry biomass yields of CT, CIR and FB were 16.85, 15.90 and 4.50 ton/ha/year, respectively ($P < 0.0001$). Significant difference was also observed for height among CT, CIR and FB (177.59, 169.98 and 94.89 cm, respectively; $P = 0.0002$). There were no significant differences in energy content ($P = 0.96$) and chemical composition among varieties ($P > 0.05$). It appears that Carthage and Cave-in Rock are better adapted to South Korea climatic conditions than Forestburg as a biomass feedstock source.

Key Words: South Korea, bioenergy feedstock, cultivar, planting date

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1119 (W106) Morphological composition of Piata palisade grass tillers subjected to strategies of intermittent defoliation.

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It was aimed to evaluate the morphological composition of tillers of Piata palisade grass (*Brachiaria brizantha* cv. Piata) under different combinations of defoliation frequency and severity. The trial was carried out in Vicosa - MG, Brazil, from December 2012 to March 2013. The treatments consisted to combinations of two post-cutting heights (15 and 20 cm) and two pre-cutting frequencies (95% and 100% light interception, LI_{95} and LI_{100}) and were allocated to experimental units (14 m^2) with three replications according to a 2x2 factorial arrangement in a randomized complete block design. Canopy light interception was measured using a canopy analyser LAI 2000 and sward height using a sward stick. The following variables were evaluated: the number of live and dead leaves per tiller, the length of leaf blades and the length of stem. Data were analysed using the mixed procedure of SAS. The number of live leaves was not affected by management strategies ($P > 0.10$), staying on average 4.5 live leaves per tiller. However, the number of dead leaves per tiller was lower ($P < 0.10$) for swards managed with the LI_{95} than those managed with the LI_{100} (1.25 and 1.79, respectively). Additionaly, swards managed with the LI_{95} had lower ($P < 0.10$) stem length (19.15 cm) than those managed with the LI_{100} (27.76 cm). The length of leaf blade also was lower ($P < 0.10$) with LI_{95} strategies than with LI_{100} (18.04 and 27.43 cm, respectively). There were no effects ($P > 0.10$) of two post-cutting heights (15 and 20 cm) on all variables evaluated. The Piata palisade grass managed with the LI_{95} target had lower number of dead leaves and shorter length of stems and leaves, which corresponds to more favorable sward structure to intake by grazing animals. *Funded by Fapemig.*

Key Words: management, pasture, tropical grass

1120 (W107) Chemical composition and in situ dry matter degradability of tropical forages grasses in Northeastern Brazil. S. S. C. Sanches, R. C. Rodrigues, M. O. M. Parente*, I. G. R. Araújo, C. M. S. Galvão, A. L. Silva Júnior, S. Figueredo, R. A. Araújo, I. Rodrigues, and S. S. Mendes, *Universidade Federal do Maranhão, Chapadinha, Brazil.*

Brazil has an area of more than 220 million ha of pasture, and at least 100 million ha are cultivated pastures. Thus, tropical grasslands represent an important resource for the Brazilian cattle industry. The chemical composition and ruminal in situ dry matter (DM) degradability of nine tropical forages grasses in Baixo Parnaíba, Maranhão were evaluated. The forages were harvested at 35 d of growth and the cutting height was 15 cm of soil. One Santa Inês male sheep (BW 63 kg) cannulated in the rumen was used for feed incubation. Samples of 5 grams of each forage were incubated in the rumen in nylon bags. For each time of incubation four bags were used. The experiment followed a completely randomized design in a 3x9 factorial arrangement (three times of incubation – 6, 24 and 96 h and nine species — *Brachiaria humidicola, Brachiaria* hybrid cv. Mulato, *Brachiaria brizantha* cvv. Piatã, Xaraés and Marandu, *Brachiaria ruziziensis*, *Brachiaria decumbens, Panicum maximum* cv. Massai and *Andropogon gayanus*). The *P. maximum* cv. Massai grass presented higher ($P < 0.05$) protein content (7.4%) than *B. humidicola* and *A. gayanus* (3.3 and 3.6, respectively), whereas the NFD, AFD, cellulose and lignin contents didn't differ among grasses. The content of hemicellulose was lower in *P. maximum* cv. Massai, *B. decumbens*, and *A. gayanus* grasses. Higher values of DM disappearance of tropical grasses were found in 96 hours (mean value 36.16, 55.52 and 80.20% for 6, 24 and 96 h, respectively). *B. decumbens* had higher values of effective digestibility (ED) in three passage rates (PR): 67.7, 57.1 and 51.3% in PR of 2, 5 and 8%, respectively. *B. humidicula* and *P. maximum* cv. Massai grasses had the lowest potential degradability, 78.9% and 77.6%, respectively. The nonlinear model was adjusted satisfactorily to data from DM. The coefficients of determination (R^2) obtained for the curves of degradability in both for age degradability were greater than 93%.

Key Words: *Andropogon gayanus*, *Brachiaria* spp., *Panicum maximum*

1121 (W108) Influence of phenological stage on fresh forage, hay and silage on nutritional value of tall wheatgrass. M. Menghini[1,2], H. M. Arelovich*[1,2,3], M. F. Martínez[1], and R. D. Bravo[1], *[1]Dto. Agronomía, Universidad Nacional del Sur, Bahía Blanca, Argentina, [2]CIC, Bahía Blanca, Argentina, [3]CERZOS, Bahía Blanca, Argentina.*

The objective was to compare the nutritional value of two methods of forage conservation and fresh forage (type of forage=TF) of tall wheatgrass (*Thinopyrum ponticum*) in 5 different phenological stages (PhS). The experimental units were 5 m^2 plots randomly distributed upon a uniform stand of tall wheatgrass in a complete randomized design ($n = 3$). Clipping dates were 113, 142, 163, 190 and 211 d after regrowth related to the stages vegetative (V), booting (B), anthesis (A), milk (M) and dough-grain (D) respectively, on standing fresh pasture (P), hay (H) and silage (S). Clipping was mechanical at 10 cm height and dry matter yield (DMY) was measured. Subsamples from each experimental unit were used for: (1) DM determination of P, (2) preparation of H by drying sheltered at environmental temperature (72 h), and (3) preparation of S in PVC cylinders with 2 kg fresh forage carrying capacity (60 d). All materials were analyzed for NDF, ADF, ADL, soluble non structural carbohydrates (SNSC), IVDMD and CP. Data was analyzed by ANOVA and means compared by Tukey ($\alpha = 0.05$). Results are reported in Table 1121. A significant interaction TF x PhS was found for all variables with the exception of CP and ADL. Only A could be an adequate alternative for S. However, at B, A, M and D the H conservation method would preserve an appropriate nutritive value as well.

Key Words: forage conservation, nutritional value, *Thynopirum ponticum*

Table 1121. Nutritional value (%) for tall wheatgrass at different PhS and for different TF

PhS	TF	DM	NDF	ADF	ADL	SNSC	IVDMD	CP	DMY
V	P	38.0[a]	70.2	35.7	3.0	15.1[a]	52.4	12.6	1393[a]
	H	91.9[b]	67.5	35.8	2.6	13.1[a]	54.3	11.3	
	S	41.7[a]	66.8	37.9	3.7	1.96[b]	50.9	11.2	
B	P	36.1[a]	70.3[a]	36.3[a]	4.8	23.8[a]	55.4[a]	9.5	2047[a]
	H	91.6[b]	72.8[b]	38.5[b]	5.3	12.4[b]	47.0[ab]	10.0	
	S	37.5[a]	70.9[ab]	40.1[c]	6.1	3.5[c]	38.9[b]	9.07	
A	P	40.8[a]	72.1	38.7	5.3	24.2[a]	50.3	7.3	3215[b]
	H	92.4[b]	73.2	39.7	5.5	12.7[b]	46.3	8.1	
	S	43.4[a]	71.6	41.2	6.1	1.2[c]	43.5	7.3	
M	P	51.3[a]	68.4[a]	36.9[a]	5.0	18.8[a]	49.3[a]	6.6	3338[b]
	H	92.1[b]	71.8[b]	40.4[ab]	5.9	16.5[a]	48.4[a]	7.0	
	S	50.6[a]	72.5[b]	47.0[b]	7.2	4.9[b]	40.7[b]	7.1	
D	P	60.4[a]	72.1	43.7	6.3	17.7[a]	46.7	5.5	3812[b]
	H	92.9[c]	71.2	44.4	5.9	17.2[a]	49.8	5.7	
	S	63.9[b]	71.4	45.3	6.0	11.8[b]	48.2	5.2	

PhS: phenological stage; TF: type of forage.
[a,b,c] Differ within each PhS ($P < 0.05$)

1122 (W109) Spatio-temporal evaluation of the nutritive value of *Croton cortesianus* and *Leucophyllum frutescens* through in vitro fermentation kinetics.

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The aim of the study was to evaluate, seasonally, two native shrubs which are commonly selected by white-tailed deer in a semiarid and subtropical area of Northeastern México. Foliage from *Croton cortesianus* and *Leucophyllum frutescens* was sampled from Summer 2004 to Spring 2005 in two country sites: China and Linares in the state of Nuevo Leon, México. In vitro gas production was recorded at 3, 6, 9, 12, 24, 48, 72 and 96h. Kinetic parameters such as the asymptotic gas production (B), rate of gas production (*k*) and lag phase (L) were estimated by the exponential model $G = b \times (1 - e^{-k(t-L)})$. Microbial protein synthesis, ME content and in vitro organic matter digestibility (IVOMD) were also evaluated. Data were analyzed according to a completely randomized design with factorial arrangement. The factors were sampling sites, shrub species and seasons. Kinetic parameters significantly varied among shrubs, sites and seasons ($P < 0.001$). The asymptotic gas production (B) ranged from 127 ml of gas/g DM in *C. cortesianus* in summer 2004 in China country to 237 ml of gas/g DM in *C. cortesianus* in spring 2005 in Linares country. The rate of gas production (*k*) was the lowest ($P < 0.05$) in *C. cortesianus* in summer 2004 (0.035%/h) while the highest (0.144%/h) was collected in autumn 2004 in Linares. Values regarding L ranged from 0.05 to 2.89 h, and were superior ($P < 0.05$) in *C. cortesianus* during autumn 2004 in Linares country. Interactions sites x shrub species x seasons were significant ($P < 0.001$) for all kinetic parameters. Microbial protein synthesis measured as purines varied significantly among shrubs and seasons. Mean values ranged from 1.51 to 11.36 µmol, and were lowest ($P < 0.05$) in *C. cortesianus* in spring 2005 in Linares and highest in *L. frutescens* in autumn 2004 in China. The ME content varied from 0.36 to 2.71 Mcal/kg DM ($P < 0.05$). Estimates of IVOMD ranged from 46.4 to 89.7%. *C. cortesianus* had the greatest IVOMD values in summer 2004 in China ($P < 0.05$). Data suggested that although spatio-temporal fluctuations, variables such as the constant rate of gas production, which might indicate nutrient availability for rumen microorganisms (overall mean = 0.079%/h), digestibility (overall mean = 70.2%) and microbial protein synthesis (overall mean = 7.2 µmol) support the nutritive potential of *C. cortesianus* and *L. frutescens* for white-tailed deer in marginal semiarid regions of northeastern México.

Key Words: gas production, native shrubs, semiarid regions

1123 (W110) Reduction of enteric methane emission by using tannin supplementation in grazing goats.

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This study aimed providing condensed tannin (*Schinopsis quebracho*) to reduce methane (CH_4) emission and if it keeps through time. Twelve Anglo Nubian breed goats were used with an average 56 kg of body weight (BW) in Tanzaniagrass (*Panicum maximum*) pasture with access to water and mineral salt managed under intermittent stocking with 11 hours of grazing period during 5 d. The treatments were: control (without tannin-WT) and addition of tannin (AT). Condensed tannin contained 70% (± 2) as guarantee level in powder form was fed (at 6:00 PM) once a day individually for each animal orally 0.31 g per kg of metabolic BW ($BW^{0.75}$). Tannin was provided for 91 d with three collections of methane with intervals of 30 days and period of feces collection to estimate dry matter (DM) intake. CH_4 emission was estimate by technique tracer gas SF_6 (sulfur hexafluoride). Variables for CH_4 emission were analyzed by SAS software in a completely randomized design with two treatments in a split plot in time with two longitudinal factors (5 d and 3 periods) and 6 replications (animals). F-test ($\alpha = 5\%$) was used for comparisons between treatments and orthogonal polynomial contrast for days and grazing cycles. There was no difference ($P > 0.05$) between treatments for g CH_4 emission per animal (21.88 ± 0.8 and 20.52 ± 0.8); kg DM intake (43.07 ± 2.1 and 42.73 ± 2.0) and percentage of loss of gross energy intake (14.65 ± 0.7 and 14.54 ± 0.7) respectively for WT and AT. The higher DM intake was observed ($P < 0.05$) in WT (562 ± 9.2 g / day) treatment compared to AT (510 ± 8.7 g / day). CH_4 emission calculated in relation to $BW^{0.75}$ resulted in larger ($P < 0.05$) amount in WT (1.13 ± 0.04) than AT (0.96 ± 0.4) group. There was not observed ($P > 0.05$) reducing CH_4 emission per animal through time per CH_4/animal (20.66 g ± 0.8, 1.0 ± 22.51 g and 20.42 g ± 1.2) and per $BW^{0.75}$ (1.03 ± 0.04, 07 ± 0.04 and 1.04 ± 0.06) respectively for the period 1, 2 and 3. The similarity in CH_4 production through time is probably due to the amount of tannin provided staying below the required limits for gas reduction and affecting only the fiber digestibility which caused decrease DM intake but no effect on CH_4emission and consequently through time.

Key Words: CH_4; gas emission reduction; tropical pasture

1124 (W111) Nutritive value of buffelgrass-based diets supplemented with dried distillers grains with solubles and dried citrus pulp. N. C. Vásquez Aguilar[*1], H. Bernal Barragán[1,2], R. G. Ramírez Lozano[1], M. Cerrillo Soto[2,3], M. V. Gómez Meza[1], E. Gutiérrez Ornelas[1,2], and M. Guerrero Cervantes[2,3], *[1]Universidad Autónoma de Nuevo León, San Nicolás de los Garza, México, [2]Red Internacional de Nutrición y Alimentación en Rumiantes, Durango, México, [3]Universidad Juárez del Estado de Durango, México.*

The objective of the study was to evaluate the effect of supplementing small amounts of dried distillers grains with solubles (DDGS) or dried citrus pulp (DCP) upon the nutritive value of buffelgrass (*Cenchrus ciliaris* L)-based diets. Twelve experimental diets were formulated using three qualities of buffelgrass: low (3.0% CP, 70% NDF), medium (5.6% CP, 66.5% NDF) and high quality (12.4% CP, 60.8% NDF) and four levels of supplementation (0%, 10% DCP, 10% 50DCP:50DDGS, and 10% DDGS). Utilized DCP and DDGS contained 3.8% and 30.6% CP, respectively. Sample contents of ash, crude protein (CP, Leco), neutral detergent fiber (NDF), hemicellulose, cellulose, lignin, and ether extract (EE) were determined. The in vitro dry matter digestibility (IVDMD; Daisy^{II}, ANKOM), and in vitro gas production (GP) at 0, 3, 6, 9, 12, 24, 48, 72 and 96 h were measured, and fermentation parameters *a*, *b*, and *c* were calculated. Metabolizable energy (ME) content was calculated from the gas production, protein and ether extract content. Each treatment was replicated four times, and results were evaluated according to a 3 x 4 factorial arrangement of treatments, using SPSS software. There were no significant ($P > 0.05$) grass quality x supplement interactions. Ash and protein contents were respectively 30% and 70% less for low- than for high-quality buffelgrass-based diets. Diets made up of high quality buffelgrass had 14% less NDF content, 7% lower hemicellulose, 19% less cellulose and 29% lower lignin content than diets based on low quality buffelgrass (68.1% NDF, 30.9% hemicellulose, 32.5% cellulose, and 4.7% lignin, DM basis). IVDMD was 81.8% for high quality-, and 67.2% for low quality-buffelgrass-based diets, and inversely correlated (r:-0.832; $P < 0.001$) with NDF content. ME content of diets was 26% higher ($P < 0.05$) in high quality-, than in the low quality-grass based diets (1424 Kcal ME/ kg DM). Addition of DDGS increased ($P < 0.05$) 28% the ether extract and 34% the protein content of buffelgrass. Addition of DCP and DDGS to the diet increased in average 5.5% ($P < 0.05$) the IVDMD of non-supplemented buffelgrass (72.5%). In vitro fermentation parameters *a*, *b*, and *c* were neither affected by grass quality nor by type of supplement ($P > 0.05$). In conclusion, quality of buffelgrass determined the nutritive value of diets; supplementing DDGS increased protein and fat content and DCP improved IVDMD.

Key Words: buffelgrass, dried citrus pulp, dried distillers grains with solubles

1125 (W112) Lignin concentration and its correlation with degradability of tropical grasses. A. Vargas Velásquez[*], *Universidade de São Paulo, Pirassununga, Brazil*

Lignin inhibits the degradation of structural carbohydrates in the plant cell wall, thus, a precise and accurate method to determine lignin concentration is desirable. The spectroscopic acetyl bromide lignin (ABL) method has recently been receiving more attention by researchers and in this study it was compared to ADL, KL and permanganate lignin (PL). Five species of grasses, *Brachiaria brizantha* cv. Marandú*, Brachiaria brizantha* cv. Xaraés*, Panicum maximum* cv. Mombaça*, Pennisetum purpureum* cv. Cameroon and *Pennisetum purpureum* cv. Napier, harvested at seven maturity stages were used. Three fibrous preparations: NDF, ADF and cell wall (CW) were used to determine lignin concentrations. Protein (N x 6.25) and ash content were determined in the NDF and CW residues. A completely randomized experimental design with duplicate analysis for the lignin assays was used. A randomized block design was used for the in vitro experiment, with rumen fluid blocked by week. Individual treatments were compared by Tukey´s test ($P < 0.05$). Correlation coefficients between lignin methods and in vitro digestibility values were obtained using PROC CORR from SAS. The mean CW values were higher ($P < 0.05$) than NDF values, 768.1 g/kg versus 713 g/kg, reflecting solubilization of pectin and other neutral detergent soluble cell wall oligosaccharides. The ADL method yielded the lowest mean values ($P < 0.05$) of all methods, 95 g/kg versus 107.6, 116.2 and 199.1 g/kg for KL, PerL and ABL, respectively, which may indicate partial lignin solubilization by the acid detergent solution and/or by the 72% sulfuric acid solution. Results obtained by PerL were higher ($P < 0.05$) than those of ADL, possibly due to hemicellulose and pectin oxidation by potassium permanganate. The values for KL were higher ($P < 0.05$) than those of ADL, possibly due to protein contamination. The highest concentrations were obtained by the ABL method. In vitro dry matter degradability showed high negative correlation with lignin content, -0.8505, -0.9130 and -0.8883 when determined by ADL, PerL and ABL, respectively. A proposed correction factor (2.23) applied to the ADL values resulted in a degradability curve similar to the ABL curve. It is interesting to note that this value of 2.23 is very close to the 2.4 value used in the Cornell Net Carbohydrate and Protein System equations $B_2$and C, to estimate carbohydrate fractions, when adjusting lignin content. The ABL method is an easy, fast and convenient method to determine lignin content in forages.

Key Words: lignin, ABL, digestibility

1126 (W113) Chemical characterization and in vitro fermentation activity of tropical legumes.

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Leguminous species are relevant as feed resources for grazing ruminants in a diversity of agro-ecosystems. Foliage from *Albizio lebecoide, Ormosia panamensis, Centrosema pubescen, C. pubescen* cv Bani*, Pongania pinnata and Albizia lebbeck* from the oriental region of Cuba was chemically characterized and the in vitro fermentation activity evaluated. Plots from various locations at the Rio Cauto's Valley were demarcated and fifteen plants at a vegetative stage were randomly selected. Small leaves and twigs were collected simulating animal grazing. Samples were composite, dried and milled. Chemical composition, in vitro dry matter digestibility (IVDMD), total polyphenols and antioxidative activity using 1,2-diphenyl-2-picrylhydrazyl (DPPH) were determined. Glass syringes were used and gas production recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96h after incubation initiated. Inoculum from three rumen fistulated sheep fed alfalfa hay and comercial concentrate (70:30) was utilized. Kinetic parameters such as the asymptotic gas production (*b*) and the rate of gas production (*k*) were obtained by the exponential model $G = b \times (1 - e^{-k(t-L)})$. Data related to kinetic parameters *b* and *k,* chemical composition, total polyphenols and antioxidative activity were analyzed according to ANOVA for a completely randomized design. Significant variation ($P < 0.05$) was registered among legume species in all the studied variables. Except for *O. panamensis*, all species had a CP content greater than 15% ($P < 0.05$). Values related to NDF ranged from 51.1% in *O. panamensis* to 59.1% in *C. pubescens* cv bani. Intermediate values were obtained in *P. pinnata* ($P < 0.05$). In vitro dry matter digestibility varied ($P < 0.05$) from 37.3% in *A. lebbek* to 61.5% in *C. pubescens* cv bani. *Centrosema* species exhibited the greatest asymptotic gas production ($P < 0.05$; mean values for *Centrosema*= 182 ml gas/ g DM). Rate of gas production (*k*) ranged from 0.0154% h^{-1} to 0.0549% h^{-1}. *Centrosema* species had superior *k* values as well ($P < 0.05$). Total polyphenols ranged from 1.62% in *A. lebbeck* to 0.29% in both *Centrosema* species ($P < 0.05$). Accordingly, antioxidative activity (overall mean = 92.7%) was greatest in those species containing superior levels of total polyphenols ($P < 0.05$). Among species, *Centrosema* species were of reasonably good quality (CP, 17.7%, IVDMD, 61.5%, DM basis). Moreover, the greatest values regarding the extent (*b*) and rate (*k*) of gas production observed in such species which indicate better nutrient availability for rumen microorganisms, might support their potential in marginal tropical and subtropical regions.

Key Words: legumes, in vitro gas production, chemical composition

1127 (W114) Modeling dry matter production in *Panicum maximum* grasses.

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The achievement of DM production models for tropical grasses is almost absent in literature, despite the importance for livestock production, especially when considering climate chances, and it has effects on rain and temperature distribution. Models could be used as tools to adjust stocking rate and strategic planning for pasture during the year. The *Panicum maximum* grasses have high DM production (DMP), 30 ton of DM/ha.year on average, and that's why their use is becoming more common in tropical countries. The objective was to determinate a DMP model, using three cultivars of *Panicum maximum* (Mombaça, Colonião and Sempre-verde), and weather variables.A database was used ($N = 180$) based on pre-defoliation criteria as 95% of light interception, and 50% of height residue. Data were collected between December of 2012 and January of 2014. The variables minimum temperature (°C, MIN), MIN^2, average temperature, maximum temperature, insolation (hours of light/d), precipitation (PCT, mm/d) and fertilizer (FTZ, kg of nitrogen/d) were tested by Stepwise procedure ($P < 0.010$) to determinate the variables that better determinate DMP. Afterwards, the effect of cultivars on selected variables were also tested. The variables MIN^2, FTZ and PCT were chosen by the procedure Stepwise, and they were affected by the cultivars ($P < 0.040$). The intercept was also affected by cultivar ($P = 0.042$). The adjusted equations are: $DMP_{Mombaça}$ (kg/d) = -92.88 + 0.56×MIN^2 + 10.55×FTZ + 3.52×PCT ($r^2 = 0.73$, MSE = 1198, AIC = 566); $DMP_{colonião}$ (kg/d) = -35.44 + 0.42×MIN^2 + 15.67×FTZ + 0.27×PCT ($r^2 = 0.51$, MSE = 1809, AIC = 570); $DMP_{sempre\text{-}verde}$ (kg/d) = -69.33 + 0.46×MIN^2 + 7.03×FTZ + 4.21×PCT (r^2= 0.63, MSE = 1562, AIC = 694). Colonião was the cultivar most responsible to fertilizer, less sensitive to temperature and had the greater DMP, whereas Sempre-verde was the most responsive to precipitation, which shows that their production is more distributed throughout the year in tropical countries. Finally, Mombaça was the most responsive to temperature, with a production strongly affected by weather condition. Nevertheless, despite Colonião having greatest DMP, data from literature shows that it has a small leaf/steam relationship. This variation on morphological components affects their nutritive value, and that's why it's important to develop models capable of stratifying their components for purpose of complementing DMP models. In conclusion, this model is capable to predicting DMP and it is strongly affected by cultivar.

Key Words: Colonião, Mombaça, Sempre-verde

1128 (W115) Productive performance of *Atriplex canescens* forage for 30 years of exclusion and grazing in different seasons of the year in the north of México. E. Suarez*, *UAAAN, Saltillo, México.*

The shortage of forage in rangeland of northern México is becoming more serious every year. Using some shrubs such as saltbush [*Atriplex canescens* (Pursh) Nutt.], can be a feeding strategy because of its high nutritional value. Additionally, its utilization improves ecosystems. Therefore, the use of shrubs improves the productivity of rangelands. The objective of this study was to determine whether the exclusion and/or livestock grazing affect dry matter production of saltbush scrub parvifolio in northern México. Production of dry matter in kg/ha during the four seasons (2012 to 2013) (free-range grazing vs. exclusion) was determined. The plots are distributed in two sites. To collect forage samples quadrant method was used. The data were analyzed using PROC GLM of SAS. The results were a highly significant difference ($P < 0.0001$) was found between the grazing exclusion treatment and the free grazing treatment during every season of the year, for the grazing exclusion site (spring, summer, fall and winter), means of (97.5, 355, 262.5, 95 kg MS/ha, respectively) were found and for the grazing site (65, 274, 144.5, 52.5 kg MS/ha, respectively). Also, a highly meaningful difference between both grazing exclusion and free grazing treatments of ($P < 0.0022$) was found, whose means are (202.5 and 134 kg MS/ha, respectively). With the above we conclude that the shrubs that remained in grazing exclusion can improve the productivity of rangelands and solve the shortage of fodder in times of crisis. On the other hand, where there had been free grazing, the implementation of management strategies to reduce the negative effects of over-consumption of this shrub by livestock is fundamental.

Key Words: forage, chamizo, fourwing saltbush, grazing, exclusion