

Forages and Pastures: Forage Quality

T107 Forage yield and quality assessment of tall fescue varieties. D. J. R. Cherney^{*1}, J. H. Cherney¹, and D. Parsons², ¹*Cornell University, Ithaca, NY*, ²*University of Tasmania, Hobart, Tasmania, Australia*.

Tall fescue (*Festuca arundinacea* Schreb.) varieties available has increased dramatically in the past few years, and comparisons of varieties for yield and quality are needed. Our objective was to evaluate a method to compare yield and digestibility of entries cut on the same spring day by adjusting yield and digestibility to the same NDF level. Bias occurs if varieties are harvested either on the same day or at the same maturity stage on different days. A system is needed to compare relative yield and forage quality of a group of varieties at the optimum harvest date for each variety, based on total fiber content. This was accomplished by determining the linear rate of change of yield and quality over time. Five separate environments from 2003 to 2009, each with from 3 to 18 tall fescue varieties and 2 to 6 replicates, were sampled for yield and quality using a quadrat (0.06 m or larger) and clippers. Experimental design was an RCBD with a split plot feature, with varieties as the main plot and sampling dates as the sub plots. Sites were located in Chazy, Freeville, and Ithaca, NY. Each trial had at least 5 different spring sampling dates separated by 2 to 4 d between mid-May to early June. Rates of daily change were determined using regression analysis, and analysis of covariance was used to determine if slopes were equal. Rates of change per day of yield and quality were different ($P < 0.05$) across environments, but varieties within a given environment did not differ ($P > 0.05$) in NDF, in vitro NDFD, or yield rate of change per day. Across environments NDF concentration increased from 8 to 12 g/kg/day, while digestible fiber decreased from 7 to 12 g/kg/day. Rate of change in CP was very consistent, decreasing an average of 5.6 g/kg/day over all environments. Rate of change in DM yield was relatively consistent within each environment, but varied from 115 to 275 kg/ha/day across environments. Based on our results, it is possible to sample representative varieties during a period of linear change starting in mid-May and use this information to adjust yield and quality of all entries in a variety trial to their individual optimum harvest dates based on NDF content.

Key Words: tall fescue, digestibility

T108 Yield and chemical composition of forage soybeans relative to seeding rate and stage of harvest. B. G. Buller^{*}, W. A. Storer, D. D. Kee, M. M. Fennel, M. A. Idlett, W. B. Brumbaugh, and F. M. LeMieux, *McNeese State University, Lake Charles, LA*.

Two experiments were conducted to evaluate a glyphosate resistant forage soybean (Big Fellow RR) in an effort to identify an alternative high protein forage for cattle producers along the Gulf Coast. The aim of this study was to identify the seeding rate and harvesting stage that optimized forage yield and chemical composition of this soybean. "Big Fellow RR" soybeans were evaluated at different seeding rates and harvesting dates at 2 locations (Lake Charles and Kinder, LA). Soybeans were planted in May of 2009. Both experiments were designed in a complete randomized block arrangement. Seeding rate ranged from 148,000 to 445,000 seeds per hectare. Stand counts, stalk diameter, plant height, and growth stage were evaluated at least twice monthly. Harvesting was conducted from August to mid October to determine responses in yield and chemical composition parameters. Seeding rate did not affect ($P > 0.1$) survival rate or yield in dry matter per hectare. Conversely, individual plant population, height, weight, stalk diameter,

and CP were greater ($P < 0.05$), while ADF and NDF were lower ($P < 0.05$) in the lowest population. Percentages of starch, oil, and dry matter, across all seeding rates, increased ($P < 0.05$) between d 102 (R2) and 130 (R5). Dry Matter yield increased ($P < 0.05$) with time. These results indicate, contrary to popular opinion with producers, lower seeding rates may optimize forage cost efficiency and chemical composition. Conversely, higher seeding rates would aid in reducing stalk diameter. This study aided in clarification of ideal seeding rate, harvesting date and established the potential for production of forage soybeans along the Gulf Coast.

Key Words: soybean, forage, seeding rate

T109 Chemical constituents of *Cynodon* spp. varieties. C. L. Gordin, E. R. de Oliveira^{*}, L. L. Freitas, F. W. Pedroso, R. H. de Tonissi e Buschinelli de Goes, B. Lempp, S. F. Luna, W. S. Prado, L. H. X. da Silva, C. W. S. Gavilan, and A. M. de Araújo Gabriel, *Universidade Federal da Grande Dourados, Dourados, MS, Brasil*.

The chemical composition of 3 *Cynodon* spp. varieties (Tifton 68, Tifton 85, and Jiggs), in different harvesting ages, were evaluated. The experiment was carried of December 2008 to February 2010, at the animal science sector of Dourados Federal University. Dry Matter, CP, NDF, and ADF determinations were processed at UFGD's Animal Nutrition laboratory. The experimental design consisted of random blocks with treatments organized in a split-plot arrangement that comprised 3 varieties (plots) and 4 harvesting ages (subplots) (28, 48, 63, and 79 d), with 4 replicates. The data were evaluated by the Scott-Knott's test at 5% probability using the SAS statistical package. Analysis was conducted on whole plant (T), leaf (F), and stem (C) fractions for each variety. There was difference ($P < 0.05$) for varieties, for NDF, ADF and CP in whole plant, NDF, ADF in leaf and CP in stem. Jiggs presents for whole plant averages of 77.02 ± 4.3 , 36.40 ± 3.1 and $10.7\% \pm 2.6$, for NDF, ADF and CP, respectively. NDF and ADF for Jiggs leaves were $78.4\% \pm 7.9$ and $35.5\% \pm 6.0$ and CP of stem was $8.2\% \pm 2.4$. These data demonstrate that the greater values for fiber and lesser values for protein by Jiggs justify the highest value found for Dry Matter of whole plant (91.38%), this can be explained by age of harvesting and age of varieties. As for harvesting age, Jiggs variety showed a leaf ADF increase 30.20%, as it increase the harvesting times, with an average of 40.77% at 79 d. This may have contributed to increase ADF in whole plant for Jiggs. As we increase the fiber content of whole plant was reduced by 30% in crude protein. There were no differences ($P > 0.05$) for the other *Cynodon* varieties evaluated, with presents averages 72.9, 35.5, 13.1%, for NDF, ADF and CP in whole plant, 71.6 and 31.4 for NDF and ADF in leaf. CP stem in Tifton 85 and Tifton 68, was 10.6%. The harvest age does not alter chemical compositions of these *Cynodon* varieties. Jiggs variety presents lower nutritional values in relation to the contents found in Tifton 85 and Tifton 68.

Key Words: Jiggs, nutrients, Tifton

T110 Chemical composition evaluation of different *Cynodon dactylon*. F. W. Pedroso, E. R. de Oliveira^{*}, L. L. Freitas, C. L. Gordin, R. H. de Tonissi e Buschinelli de Goes, B. Lempp, S. F. Luna, W. S. Prado, L. V. Moura, F. P. Monção, A. M. de Araújo Gabriel, and C. W. S. Gavilan, *Universidade Federal da Grande Dourados, Dourados, MS, Brasil*.

The aimed of this study was to determine which genotype and harvesting age among *Cynodon dactylon* would show the best chemical characteristics as parameters for feeding ruminant animals in the state of Mato Grosso do Sul, Brazil. The experiment was conducted at Agrarian Science College of Dourados Federal University, from August 2009 to January 2010. A random block design was used and treatments were arranged in a split-plot scheme with 3 genotypes (Tifton 68, Tifton 85, and Russell) representing plots, at 4 harvesting frequencies (28, 48, 63, and 79 d) as subplots, with 4 replicates. Evaluations were done after a uniform cut and the materials collected for the laboratory were processed as DM, NDF, ADF, and CP analyses. The data were evaluated by the Scott Knott's test at 5% probability using the SAS statistical package. The following variables were analyzed: entire plant (T), leaf (F), and stem (C), within each genotype. There was no difference ($P < 0.05$) for harvesting frequencies. There was no difference ($P > 0.05$) for leaf and stem DM, where Tifton 85 and Russell presents averages of 91.60; 91.66; 91.39; and 91.27%, respectively. There was a difference ($P < 0.05$) for NDF and ADF, for whole plant and leaf. Russell presents a higher values, with averages 80.41 and 37.26% for NDF and ADF, in whole plant, respectively; for leaf the averages was 82.65 and 34.02%, for NDF and ADF, respectively. The others genotypes present averages of NDF of 72.9 and 71.6, for whole plant and leaf, respectively; and 35.1 and 31.4% of ADF for whole plant and leaf. Russell variety presents higher fiber contents, it is suggested that Tifton 85 and Tifton 68 allow a better use of these nutrients. All the *Cynodon dactylon* evaluated can be used in ruminant feeding

Key Words: forage, genotype, nutrients

T111 Chemical composition of three grasses of *Cynodon dactylon*. L. L. Freitas, E. R. de Oliveira*, F. W. Pedroso, C. L. Gordin, R. H. de Tonissi e Buschinelli de Goes, B. Lempp, S. F. Luna, W. S. Prado, F. P. Monção, L. V. Moura, and A. M. de Araújo Gabriel, *Universidade Federal da Grande Dourados, Dourados, MS, Brasil.*

This experiment aimed to identify which *Cynodon dactylon* varieties would have the best harvesting intervals to produce the best chemical characteristics as a reference for use in ruminant feeding. The experiment was conducted at the animal nutrition laboratory located at Agrarian Science College, of Dourados Federal University, in Mato Grosso do Sul state, located at latitude: 22°14'S, and longitude: 54°49'W, between August 2009 and January 2010. In the initial period, the experiment was installed in the field: 3 varieties of *Cynodon dactylon* were planted (Tifton 85, Tifton 68, and Vaqueiro), with 4 replicates for each variety. Forage was harvested at 28, 48, 63, and 79-d harvest intervals. The materials collected were taken to UFGD's animal nutrition laboratory and were analyzed for DM, NDF, ADF, and CP analyses. A random block design was adopted, with treatments organized as a split-plot arrangement. The averages were evaluated by the Scott Knott's test at 5% probability using the SAS statistical package. Analyses were conducted on whole plant (T), leaf (F), and stem (C) for each variety. There was effect ($P < 0.05$) for NDFC, ADFT, and CPF, for varieties. Vaqueiro variety presents averages of 85.31; 35.66; and 17.03%, for NDFC, ADFT, and CPF, respectively. Tifton 85 and Tifton 68, presents values of 77.31, 35.53, 14.76% and 77.23, 34.69 and 15.6% for NDFC, ADFT, and CPF. For NDFC occurred variety x harvest intervals interaction, where NDFC from vaqueiro variety increased after 63 d of harvesting with average of 87.50%, 17% higher at 28 d of harvest, T-85 and T-68, does not change the NDFC when increases the harvesting days, which averages of 71.6 and 74.5%, respectively. These values are consistent with physiological growth of forages. All varieties, decrease CPF with harvesting days ($P < 0.05$). Vaqueiro in 28 d of harvest presents

average of 21.97%, 28% higher in relation of values 79 d of harvest. T-85 and T-68 presents greatest CPF in 28 d of harvest, with values of 18.8 and 19.9%. Vaqueiro variety had the best response for chemical composition in relation to the other varieties, and responded to harvest date differently that T-85 and T-68.

Key Words: forage, Vaqueiro, Tifton

T112 Nutrient composition of tropical forages collected from intensively managed rotational grazing systems. J. C. Lopes*¹, R. B. Reis², A. L. Miller¹, and D. K. Combs¹, ¹University of Wisconsin, Madison, ²Universidade Federal de Minas Gerais, Belo Horizonte, Brazil.

Tropical grasses are the primary forages grown for pasture in most regions of Brazil. They are generally characterized as high-yielding, low-quality forages for high producing livestock. This study was conducted to characterize the nutritive value and fiber digestibility of 5 tropical grasses that were produced under intensive rotational grazing management in the west of the southeastern region of Brazil. Samples of *Brachiaria brizanta* (cv. Braquiaraõ, cv. Marandu, cv. MG-5); *Cynodon dactylon* (cv. Coast-cross, cv. Tifton-85); *Cynodon nlemfuensis* (cv. Tifton-68); *Panicum maximum* (cv. Colônia, cv. Mombaça, cv. Tanzânia), and *Pennisetum purpureum* (cv. Cameron, cv. Napier) were collected from paddocks after less than 30 d of re-growth. Cutting height of each specie was in accordance with the recommendations using 95% of sward canopy light interception as the criterion. Data were analyzed as a split-plot in time using SAS Proc Mixed. For in vitro NDFD (IVNDFD) analysis, each sample were analyzed 3 times and digested, in duplicates, for 24, 30, and 48 h. CP, NDF and ADF ranged from 11 to 25%; 47 to 74% and 28 to 43% of dry matter, respectively. Means of 24, 30 and 48 h, in vitro NDF digestibility, were 35 ± 5, 44 ± 6, and 59 ± 5% of NDF, respectively across the forages. When averaged across 24, 30 and 48 h incubations times, IVNDF digestibility was greater for *Cynodon nlemfuensis* and *Brachiaria brizanta* than *Panicum maximum*, *Pennisetum purpureum*, and *Cynodon dactylon* (50 ± 10, 48 ± 11, 46 ± 11, 45 ± 12, and 42 ± 10% of NDF, respectively). There were no specie by incubation time interactions for IVNDFD ($P > 0.21$), which suggests that between 24 and 48 h, rates of IVNDFD disappearance were similar among forages. These results illustrate that when harvested early, tropical forages from intensively managed pastures can be relatively high in crude protein, low in fiber, and high in fiber digestibility.

Key Words: tropical grasses, NDF digestion, in vitro

T113 In vitro nutritional evaluation of spiny and spineless *Opuntia cladodes*. J. A. Santos-Haliscak¹, E. Gutiérrez-Ornelas*^{1,4}, M. A. Cerrillo-Soto^{2,4}, H. Bernal-Barragán^{2,4}, and O. La-O^{3,4}, ¹Universidad Autónoma de Nuevo León, San Nicolás de los Garza, Nuevo León, México, ²Universidad Juárez del Estado de Durango, Durango, Dgo., México, ³Instituto de Ciencia Animal, La Habana, Cuba, ⁴Red Internacional de Nutrición y Alimentación en Rumiantes, San Nicolás de los Garza, Nuevo León, México.

The objective of this study was to evaluate nutritional properties of 3 spiny (SO) and 3 spineless (SLO) *Opuntia ficus-indica* varieties using in vitro gas production (GP), in vitro true DM digestibility (IVTDM; DAISY¹¹), and chemical composition techniques. Four field blocks with 10 Cactus cladodes of each variety were planted on September of 2006 at a planting distance of 0.5 m between plants and 2.0 m among varieties. Total cladodes produced from 3 plants in each experimental unit were collected on November of 2007. Samples were chopped, dried on 60°C oven and ground to pass 1 mm screen. Chemical composition analysis

included CP, NDF, lignin, ash and EE. Twenty-four *Opuntia* samples (200 mg DM) and one standard sample of alfalfa were incubated, by triplicate, in 100-mL calibrated glass syringes with rumen fluid obtained from 3 sheep fed alfalfa hay and concentrate (75:25). Gas volume was recorded at 0, 3, 6, 9, 12, 24, 48, 72 and 96h post-inoculation and data fitted to the model $P = a + b(1 - e^{-ct})$. The soluble fraction (a), the gas produced from the slowly degradable fraction (b) and the constant rate of GP (c) were estimated using PROC NLIN (SAS), and metabolizable energy (ME, Mcal kg⁻¹ DM) was calculated in accordance to the following equation: $ME = (2.20 + 0.136GP_{24h} + 0.057CP + 0.0029EE^2)/4.184$. Data were analyzed using a randomized block design, testing the effect of SO vs. SLO with orthogonal contrasts. There were no differences ($P > 0.05$) among *Opuntia* varieties for CP (8.5% ± 0.61), NDF (27.0% ± 2.1), lignin (4.0% ± 0.38) and ME (2.04 Mcal ± 0.07). Spineless cactus cladodes were higher ($P < 0.05$) than SO in ash (30.4 vs. 27.6% ± 0.88), IVTDMD (90.6 vs. 80.1% ± 1.1) and GP parameters a (13.4 vs. 9.3% ± 0.50) and b (61.0 vs. 53.9% ± 2.1), but SO were higher ($P < 0.05$) than SLO in their rate constant for GP c (7.7 vs. 4.8% h⁻¹ ± 0.44) and EE (0.94 vs. 0.29% ± 0.048). Alfalfa forage standard had similar or lower GP kinetic values than both *Opuntia* groups. Except by the rate constant, SLO cladodes had better digestion kinetic values than SO varieties but CP and ME values were similar.

Key Words: *Opuntia*, fermentation parameters, gas production

T114 Simple sequence repeats markers on the characterization of *Lolium* and *Dactylis* accessions. C. J. Aguirre-Robert¹, B. Alarcón-Zúñiga*¹, M. R. Venegas-Ordóñez¹, O. Hernández-Mendoza², S. S. González-Muñoz², and J. Burgueño-Ferreira², ¹*Colegio de Postgraduados, Montecillo, Edo. de México, México*, ²*Universidad Autónoma Chapingo, Chapingo, Edo. de México, México*.

The objective of this study was to carry out an agronomic and molecular evaluation of 8 accessions of *Lolium* [Ansyl France, New Zealand, Uruguay, Netherland Barenza, USA Manhattan II (UMII), Canada Uri (CU4n), Australia Wimmera 62 and France Itaque]; and 3 of *Dactylis* [Canada Hercules, USA Potomac (UP) and USA Napier], in the Mexican Highlands. To evaluate morphological traits the experimental design was randomized complete blocks with a split-plot arrangement; data were analyzed using PROC MIXED and means compared with SLICE LSMEANS ($P \leq 0.05$). Ansyl France surpassed ($P \leq 0.05$) for plant height, dry weight, leaf dry weight, and stem weight per plant; CU4n for % of leaf and stem; UP for % and dry weight of dead material per plant; and UMII for number of stems. For the molecular evaluation, DNA was extracted (modified CTBA method), then PCR, amplification and electrophoresis. To determine population structure and genetic similarity among accessions, as well as the association between loci and morphological traits, data were subjected to cluster analysis (UPGMA), PROC PLS and Nei's unbiased genetic estimators (Pop Gen 32). Out of the 13 SSR-loci, 59 alleles were identified (4.5 alleles per locus). Besides, the UPGMA analysis showed 3 groups: per species (*D. glomerata*), per ploidy level (*L. hybridum* and *L. perenne*) and per genus (*Lolium*). This means that SSRs discriminated the genotypes per species, ploidy level and genus. The relationship between genetic distances of the 13 SSR-loci and the morphological characters, estimated by PMS biplots, indicated that SSR-loci expressed up to 14.3% of phenotypic variation of morphological traits among accessions. Therefore, it may be concluded that morphological traits and genetic distances from SSR-loci may be used for selecting genotypes with the best characteristics to establish a breeding program based on genetic and phenotypic characters, for *Lolium* and *Dactylis*.

Key Words: *Lolium*, *Dactylis*, molecular evaluation

T115 Correlations among shearing force and chemical compositions of wheat stems. Z. Yang, Z. Wang*, W. Yang, S. Jiang, and G. Zhang, *Shandong Agricultural University, Tai-an, Shandong, China*.

The objectives of this study were to investigate the relationship between shearing force and chemical compositions of wheat stems. Shearing force, a fracturing property of plant stem, is an important indicator of forage value. Three varieties (YanNong21; JiMai22; ShanNong15), which were plants from different plots, were collected, and each was divided into 4 treatments (150 replicate stems per treatment) by the diameter. After seed harvesting, each stem was cut into 3 16 cm segments for measuring stem diameter and shearing force of top, middle and bottom segments of stem. The top segment was measured from the stem apex, the bottom from the harvest base and the middle segment extended 8 cm above and below the midpoint of the stem. Each segment was sheared at the approximate midpoint ensuring that the location was between 2 nodes to prevent any influence of nodes on shearing force. Shearing forces of the 3 segments were averaged as the stem shearing force. Shearing force was measured with a C-LM3 meat shear made by the Mechanics Research Center of Dongbei Agricultural University and commonly used to measure tenderness of meat tissue. Range of shearing force was 0- 25.0 kg and deformation speed was 5 mm per second. Stems that had been measured for chemical compositions were analyzed by the SAS system, including dry matter (DM), neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP), ether extract (EE), crude ash (CA), organic matter (OM), Lignin and cellulose. There was a positive relationship between DM and shearing force ($r = 0.65$), and the similar relationship for NDF ($r = 0.85$) and ADF ($r = 0.90$). Correlations were not found between shearing force and other chemical components such as CP ($r = -0.19$), EE ($r = -0.36$), CA ($r = -0.29$), OM ($r = 0.54$), Lignin ($r = 0.26$) and cellulose ($r = 0.54$). Shearing force was a direct indicator for estimating forage the chemical compositions, it can be used to predict forage value of wheat stems. Future research should evaluate correlation between shearing force and digestibility of DM, NDF or ADF.

Key Words: wheat stems, shearing force, chemical compositions

T116 Adaptation of *Brassica* spp. and fodder radishes as late season forages in the high desert region of Oregon. C. L. Engel*, B. A. Charlton, R. J. Roseberg, and R. A. Bentley, *Oregon State University, Klamath Basin Research and Extension Center, Klamath Falls*.

The objective of this study was to evaluate the yield potential and viability of winter triticale (TRT; n = 1), *Brassica* spp. (BRS; n = 6), and radish (RAD; n = 3) varieties, as late season forages. In 2009 3 planting dates (PD1, 2 and 3; July 30, Aug. 14, & Aug. 28, respectively) were analyzed with 2 harvest dates (HD; approximately 60 and 90 d after planting) per PD (4 replications per variety). Plots were arranged in a randomized complete block design with a split plot. Varieties included: winter triticale (TRT; trical102); dwarf Siberian kale, Winfred (WIN, hybrid); purple top white globe turnip; Hunter (hybrid); New York turnip; pulsar rape (PR); graza radish; colonel radish (CR); and Terranova radish. Plots were seeded with a modified Great Plains drill at 4.5, 7.9, and 112.3 kg pure live seed/hectare (ha; for BRS, RAD, and TRT, respectively) into glyphosate treated small grain stubble. Plots were fertigated with 67.3 kg nitrogen and 22.4 kg sulfur/ha after plants reached the 2-leaf stage and were irrigated through Oct. 15. Across all PD, TRT was the lowest yielding variety (3.70 ± 0.56, 2.51 ± 0.29, and 1.44 ± 0.49 t dry matter (DM)/ha; PD1, 2, and 3, respectively). The variety with the greatest yield differed by PD (WIN 7.49 ± 0.47, PR 5.31 ± 0.29, WIN 4.48 ± 0.43 t DM/ha; for PD 1, 2, and 3, respectively). For both PD 1 and 2, CR, BRS hybrids and PR yielded more than turnip and RAD varieties.

ies ($P \leq 0.05$), but by PD 3 all BRS varieties yielded more than RAD varieties ($P \leq 0.05$), with turnip varieties tending to have higher yields among the BRS group. The 60 d HD yielded less ($P < 0.01$) than the 90 d HD for PD 1 and 3, only (5.31 vs. 6.30 ± 0.20 and 2.65 vs. 4.04 ± 0.19 t DM/ha; for 60 vs. 90 d HD, PD 1 and 3; respectively). No PD \times HD interaction occurred ($P \geq 0.16$). Both BRS and RAD produced good late season yields, and seem well-suited to extend the grazing season. For earlier PD, differences between varieties were as large as differences between species, but by PD3 the BRAS varieties produced greater yields than other species.

Key Words: *Brassica* spp., forage, fall

T117 Effects of age of regrowth and geographical location on forage protein and carbohydrate fractions, silicon content, and their impact on IVOMD of four tropical grasses. K. A. K. Lee*¹, J. R. Carpenter¹, B. W. Mathews², M. S. Thorne¹, and L. E. Sollenberger³, ¹CTAHR, University of Hawaii at Manoa, Honolulu, ²CAFNRM, University of Hawaii at Hilo, Hilo, ³University of Florida, Gainesville.

In Hawaii, Kikuyugrass (KG) grown at higher elevations is lower in NDF and higher in IVOMD and CP than KG at the same age of regrowth in lower elevation sites with warmer climates. The impact of elevation on forage nutritive value may be confounded in part by differences in soil silicon (Si) between sites. The objectives of this study were to determine the effects of age of regrowth and geographical location on the nutrient composition, IVOMD, and silicon content of 4 tropical pasture grasses *Pennisetum clandestinum*, *Digitaria decumbens*, *Pennisetum purpureum*, and *Pennisetum americanum* \times *Pennisetum purpureum*. Grasses were cultivated (3 plots each) at 2 different geographical locations and harvested repeatedly at 4, 8, and 12 weeks of regrowth. Grass samples were weighed and dried at 50°C in a forced draft oven then ground by a Wiley mill (1-mm mesh stainless steel screen). Nutrient analysis of forages was determined by Near Infrared Reflectance Spectroscopy (NIRs) and sub-samples analyzed for silicon (ICPES following sample preparation by the NaOH fusion and melt dissolution procedure), and 48 h IVOMD digestibility (2-stage technique of Moore and Mott). The ranges in percent CP, protein solubility, NDF, ADF, lignin, IVOMD, and silicon (ug/g) and digestion rate (%/hr) across the 4 grasses (for both locations and the 3 ages of regrowth) were 5.3–22.4, 17–54, 52.1–74.5, 31.8–49.2, 1.3–7.8, 39.6–75.4, 407–6703, and 2.65–10.81, respectively. There were differences ($P < 0.05$) between grass varieties, geographical locations, and ages of regrowth for the various nutrient components, IVOMD, and silicon content. IVOMD was positively correlated with CP (+0.730), and negatively correlated with NDF (–0.552) and ADF (–0.747), and NDF was negatively correlated with CP (–0.789). Silicon differed ($P < 0.01$) with geographical location and grasses varied ($P < 0.01$) in silicon level within location. These research results indicate that one must be cautious in using tropical grass data from other regions and growing conditions.

Key Words: tropical grasses, nutrient composition, silicon content

T118 Effect of time from rumen fluid collection to sample inoculation on estimates of in vitro NDF digestibility. J. C. Lopes*¹, R. B. Reis², and D. K. Combs¹, ¹University of Wisconsin, Madison, ²Universidade Federal de Minas Gerais, Belo Horizonte, Brazil.

Run to run variability of in vitro NDF digestibility (IVNDFD) measures are reduced when forages are inoculated with a primed rumen inoculum that was held in a sealed flask until it reaches a pre-determined gas pressure. The time for the inoculum to reach this predetermined pressure is variable, ranging from 85 to 325 min. The objective of this

study was to determine if the time variation to reach the predetermined gas pressure affects estimates of IVNDFD. An alfalfa silage was dried (60°C), ground (1 mm), and weighed (0.5 g DM) into Ankom F57 fiber bags. Rumen fluid was collected from 2 rumen-cannulated cows and strained through cheesecloth. Rumen fluid (250 mL), mixed with Van Soest buffer (250 mL), reducing solution (40 mL), and carbohydrate/nitrogen nutrient primer (1.25 mg/mL of rumen fluid) was fermented in sealed 1000 mL Erlenmeyer flasks until pressure corresponding to 0.3 mL of gas production/mL of inoculum was attained. Time from inoculum collection to the pre-determined gas pressure was recorded. The alfalfa samples were then inoculated with the standardized inoculum and digested, in duplicate, for 24, 30 or 48 h. Residual neutral detergent fiber was analyzed with a forage fiber analyzer, and NDFD determined. The procedure was repeated 16 times. Data were analyzed as randomized complete block with replication and unequal error variance using SAS Proc Mixed. Alfalfa silage sample was the experimental unit, fermentation time and residual error were random effects, and time point and repetition were fixed effects. IVNDFD estimates differed due to time of incubation (25, 34 and 43% of NDF, for 24, 30 or 48 h, respectively: $P < 0.01$) but did not differ ($P > 0.05$) due to time for inoculum to reach predetermined gas pressure. Residual variance of IVNDFD estimates at each time point did not differ ($P > 0.26$). These results suggest that the time required for the inoculum reach the pre-determined pressure varied widely from run to run but this had no effect on estimates of IVNDFD at 24, 30 or 48 h.

Key Words: NDF digestibility, forage fiber, in vitro

T119 Time course evaluation of NDF digestibility of hay crop silage and lignin as a predictor of indigestible fiber. R. Ward¹ and R. A. Patton*², ¹Cumberland Valley Analytical Services, Maugansville, MD, ²Nittany Dairy Nutrition, Mifflinburg, PA.

An investigation was undertaken to determine appropriate incubation times for determination of IVNDFD of hay crop silages and to define lignin based equations that might predict NDF digestibility (NDFd) with high accuracy. Twenty-one hay crop silages were selected from Cumberland Valley Analytical Services samples to represent a range of lignin as a percentage of NDF (LigNDF). This data set included these silages: 3 temperate grass, 5 legume, 6 mixed mainly grass (MMG), 3 mixed mainly legume (MML), and 4 small grain silages. Three LigNDF groups (high, medium and low) were formed with a mean of 17.7%, 13.2% and 7.2% lignin as % NDF. In vitro digestibility was determined at 4, 12, 18, 24, 30, 48, 96, and 120 h in flasks by the method of Tilley and Terry. Differences among lignin groups and forage types were assessed using Proc mixed of SAS. Regression equations for IVNDFD were developed with Proc reg of SAS using stepwise elimination. Although differences among lignin groups were significant ($P < 0.01$), groups were not homogenous with respect to forage types. Forage type was also highly significant ($P < 0.01$). Hourly digestion rates for various forages were: small grain 1.06%, grass 0.97%, MMG 0.68%, MML 0.57% and legume 0.47% ($P < 0.01$). Across all forage types, NDFd was linear between 24 and 96 h. Incubation for 120 h was sufficient to remove digestible NDF. Indigestible NDF (INDF) as % of NDF was 10.3% for small grain, 17.6% for grass, 16.2% for MMG, 20.2% MML, and 23.6% for legume ($P < 0.05$). Overall, LigNDF was less well correlated ($= 4.555 + (1.027 * \text{LigNDF})$, $R^2 = 0.66$) with INDF than was lignin as % DM ($= 1.409 + (2.838 * \text{lignin \%DM})$, $R^2 = 0.81$). However, the best equation for predicting 24 h IVNDFD included LigNDF ($= 61.065 - (2.873 * \text{LigNDF}) + (0.858 * \text{CP\%}) + (0.48331 * \text{NFC})$, $R^2 = 0.92$). These data suggest that equations for NDFd might be more accurate if based on forage type, that there is little evidence for earlier NDF

digestibility time points providing increased sensitivity for evaluation of NDF digestibility, and that NIR may offer rapid, accurate assessment of NDFd in hay crop silages.

Key Words: hay crop silage, in vitro NDFd

T120 Effect of a nutrient solution on the chemical composition and in vitro fermentation parameters of wheat hydroponic forage. H. Bernal-Barragán^{2,5}, R. Luevano-Escobedo¹, A. Elias-Iglesias^{4,5}, E. Gutiérrez-Ornelas^{2,5}, A. Estrada-Angulo^{3,5}, M. Guerrero-Cervantes^{1,5}, M. A. Cerrillo-Soto^{1,5}, and A. S. Juárez-Reyes^{*1,5}, ¹Universidad Juárez del Estado de Durango, Durango, Durango, México, ²Universidad Autónoma de Nuevo León, Monterrey, Nuevo León, México, ³Universidad Autónoma de Sinaloa, Culicán, Sinaloa, México, ⁴Instituto de Ciencia Animal, La Habana, Cuba, ⁵Red Internacional de Nutrición y Alimentación en Rumiantes, Durango, Durango, México.

A study was conducted to evaluate the chemical composition and the in vitro fermentation parameters of wheat (*Triticum aestivum* L.) hydroponic forage (WHF). Treatments consisted in utilizing either water or an organic nutrient solution containing 1.5% N, 1.0% P and 1.0% K during the process of pre-germination. Seed were soaked for 24 h in one of each solution, drained and allowed to rest for another 24 h. Germinated seeds (800 g) were then distributed in 40 × 40 cm plastic trays in triplicate and placed in a 5 × 4 m green house. The hydroponic forage was harvested at 8, 10, 12 and 14 d after germination. Samples of each day were composite, dried and milled and further analyzed for CP, NDF and ADF. The in vitro fermentation profile was estimated by incubating 200 mg DM of the hydroponic samples in 100 mL calibrated glass syringes. Gas production was registered at 0,3,6, 9,12,24,48, 72 and 96h and the data fitted to the model $P = a + b(1 - e^{-ct})$, where *a* is the gas produced from the soluble fraction of feed, *b* is the gas produced from the slowly degradable fraction and *c* the constant rate of gas production. The ME content was estimated from in vitro gas production at 24 h. In vitro true dry matter digestibility (IVTDMD) was determined following the Daisy^{II} procedure. Data were analyzed according to a completely randomized design with factorial arrangement of treatments 2 × 4. The nutritive solution did not affect ($P > 0.05$) the studied variables, except for the ADF and IVTDMD where an interaction between factors were registered ($P < 0.05$). Digestibility of wheat treated with nutritive solution remained above 70% until d 12, but those treated with water were below 70% from d 10 on. Differences in CP (%), NDF (%), gas parameters *a* (ml/200 mg DM), *b* (ml/200 mg DM), ME (Mcal kg⁻¹ DM) and biomass yield (kg) were registered among harvesting days. An increment ($P = 0.06$) was also registered in the constant rate *c* (% h⁻¹). This study indicated that the utilization of a nutrient solution on wheat seeds did not affect the nutritive value of wheat hydroponic forage.

Table 1. Nutritive value, in vitro fermentation profile and biomass yield of wheat hydroponic forage

	Harvesting days				SEM	Mean	Sig
	8	10	12	14			
CP	14	15	16	18	0,7	16	**
NDF	48	52	55	58	1,0	53	**
a	9	6	4	1	1.0	5	**
b	56	54	51	50	1.0	53	**
c	0.065	0.063	0.053	0.057	0.003	0.060	NS
ME	2.4	2.3	2.1	2.0	0.07	2.2	**
Biomass yield	3.3	3.2	3.8	3.9	0.09	3.5	**

Sig = significance; **($P < 0.01$); Mean = overall mean of both treatments.

Key Words: wheat hydroponic forage, in vitro gas production, metabolizable energy

T121 Assessing digestibility of shredded *Juniperus monosperma* treated with 5% alkylation or 3% ammoniation. C. A. Roof*, S. H. Cox, and S. L. Lodge-Ivey, *New Mexico State University, Las Cruces.*

Encroaching shrubs such as *Juniperus monosperma* (JM) typically are managed via mechanical removal or treatment with herbicides. *Juniperus monosperma* leaves have a moderate nutritive value (6.0% CP, 71.7% NDF, DM basis) and shredding whole juniper shrubs may represent a potential drought feed. Traditional supplemental feeds such as hay or grain may be unavailable or cost-prohibitive during episodes of drought, and producers may prefer a less expensive alternative. Limited data exists regarding the use of shredded juniper as a drought feed resource. Therefore, the objective of the current study was to evaluate in vitro organic matter digestibility (IVOMD) of shredded JM. Using a completely randomized experimental design, approximately 100 g of JM plus enough water to equalize dry matter at 40% was added to glass jars with sealable lids. Treatments were 1) JM only (C), 2) JM plus ammonia sulfate and excess calcium oxide for reaction giving 3% ammoniation (DM basis; N) and 3) JM plus calcium hydroxide to provide 5% alkylation (DM basis; A). After treatments were added to JM, jars were covered with aluminum foil, sealed and incubated in an anaerobic glove box (approximately 90% CO₂ and 10% H₂ atmosphere) for 30 d. After incubation, treated JM was freeze-dried and ground to pass a 2mm screen. The resulting material was used to determine 96 h IVOMD. Ruminal fluid used was donated from a ruminally cannulated cow (approximately 600 kg) maintained on sudan hay (11.3% CP, 66% NDF, DM basis). Data were analyzed using Proc GLM. In vitro organic matter digestibility for each treatment was (10.1, 12.1, 11.9 ± 0.41, A, C, N, respectively) and was influenced by treatment ($P < 0.001$). Alkylation decreased digestibility by 16.5% when compared with control while control and ammoniation did not differ ($P = 0.82$). Shredded JM includes not only leaf material but woody components resulting in low IVOMD. Although treatments of 5% alkylation or 3% ammoniation did not benefit overall JM digestibility, selection of the more desirable fractions, such as leaves and bark, by the animal could improve digestibility values.

Key Words: *Juniperus monosperma*, alkylation, ammoniation

T122 Yield and quality of grasses in three different dairy regions of El Salvador. E. E. Corea Guillén^{*1}, J. M. Flores Tensos¹, L. B. Leyton Barrientos¹, J. F. Alvarado Paramoño¹, G. O. Castillo Benedetto¹, J. M. Castro Montoya¹, and J. A. Elizondo-Salazar², ¹Departamento de Zootecnia, Facultad de Ciencias Agronómicas, Universidad de El Salvador, El Salvador, ²Estación Experimental Alfredo Volio Mata, Facultad de Ciencias Agroalimentarias, Universidad de Costa Rica, Costa Rica.

Grasses are a very important feed resource for dairy cattle in El Salvador as well as in all Central America. However, they are extremely variable in terms of yield and quality which depend on age at which they are grazed and geographical area in which they are grown. Thus many producers do not know what grasses to grow in a specific area of the country and at what age they should be grazed. For these reasons, a study was conducted to establish the grass that produces the highest yield and quality in the dairy regions of La Paz, Sonsonate and Chalatenango. Star grass (*Cynodon plectostachius*), Swazi grass (*Digitaria zimbabweensis*), and Pangola grass (*Digitaria decumbens*) were tested.

Grasses were sampled at 21, 28, and 35 d of regrowth to estimate yield per grazing period and for determination of DM yield, DM, CP, NDF, and ADF concentration. The experiment was arranged in a split-split-plot design with dairy regions as main plots, grass type as split-plots, and age of regrowth as split-split-plots. Variables were analyzed using the GLM procedure of SAS 9.1. Separation of means was done using the Duncan's multiple comparison procedure. There were differences ($P < 0.01$) between regions, grass type and age of grazing for all variables studied. The findings of the study suggest that even though there was great variability between regions, grasses, and days of regrowth; Star grass produced the highest yield and presented a higher nutritional value when compared with the other grasses.

Table 1. Yield and quality of grasses in three regions of El Salvador

Region	Available DM, kg/ha	DM, %	CP, %	NDF, %	ADF, %
La Paz	1469.8 ^b	20.5 ^a	8.7 ^a	69.5 ^a	38.7 ^a
Sonsonate	1717.8 ^{ab}	17.4 ^b	12.7 ^a	67.2 ^b	38.5 ^{ab}
Chalatenango	1928.3 ^a	20.5 ^a	10.0 ^b	67.9 ^b	39.6 ^b
Grass					
Star grass	2239.8 ^a	21.3 ^a	12.0 ^a	71.3 ^a	37.6 ^b
Swazi	1562.1 ^b	19.8 ^a	9.2 ^b	66.4 ^b	38.1 ^b
Pangola	1314.0 ^b	17.4 ^b	10.1 ^b	66.9 ^b	39.6 ^a
Regrowth					
21 d	1037.3 ^c	17.4 ^b	11.5 ^a	66.6 ^b	36.6 ^b
28 d	1668.7 ^b	18.6 ^b	10.5 ^a	68.5 ^a	38.8 ^a
35 d	2409.9 ^a	22.4 ^a	9.4 ^b	69.5 ^a	39.4 ^a

a-cP < 0.01, comparing least squares means.

Key Words: grasses, grazing, forage

T123 Effect of fertilization with swine wastewater on fermentative characteristics and losses of corn silage. M. T. Cangani, R. A. Oliveira, A. C. Ruggieri*, E. Urbinati, and F. C. Basso, *Unesp/FCAV, Jaboticabal, São Paulo, Brasil.*

The objective of this trial was to study in no-tillage system, the effect of sowing and covering fertilization with swine wastewater on fermentative characteristics and losses of corn silage. The experimental design was randomized blocks with 5 treatments and 4 replications. The treatments were: T1 - control without sowing and covering fertilization, T2 - chemical fertilization (urea, simple superphosphate and potassium chloride), T3 - raw swine wastewater, T4 - swine wastewater treated in anaerobic system (2 upflow anaerobic sludge blanket (UASB) reactors in series) and T5 - swine wastewater from aerobic post-treatment (sequencing batch reactor (SBR)). The chopped material was ensiled in plastic buckets (7 L) with sand and screen to determine the effluent losses (EL). The buckets were weighed, sealed and stored at room temperature. After 60 d of fermentation the silos were weighed to quantify the gas losses (GL), opened, spoiled silage discarded and the remainder was homogenized and sampled to determine dry matter (DM), pH and ammonia nitrogen (NH₃/TN). Statistical included ANOVA and Tukey's test ($P < 0.05$). The control silage showed lower gas losses, but did not differ significantly from other treatments ($P < 0.05$). The corn silages produced with swine wastewater treated in UASB reactors (T4) showed lower effluent losses ($P < 0.05$). The DM content not differ significantly among treatments T2, T3, T4 and T5 ($P < 0.05$). The treatment T5 showed the lowest NH₃/TN content ($P < 0.05$). The pH value did not differ significantly among treatments ($P < 0.05$). The corn silages produced with swine

wastewater treated in the UASB reactors and pos-treated in aerobic SBR showed lower EL and NH₃/TN, and the DM was similar that used chemical fertilization.

Table 1. Fermentative characteristics and losses of corn silage

Treatments	GL	EL	DM %	NH ₃ /TN	pH
T1	8.72	9.02 a	33.35 a	3.65 a	4.03
T2	12.22	6.20 ab	31.00 ab	3.18 ab	4.08
T3	13.81	6.36 ab	29.74 b	3.20 ab	4.03
T4	9.86	3.28 b	28.67 b	2.80 b	4.11
T5	9.44	5.96 ab	29.99 b	1.95 c	4.03
CV %	40.58	27.44	4.94	12.17	2.05

Means followed by equal letters do not differ by Tukey test ($P > 0.05$).

Key Words: effluent losses, gas losses, no-tillage system

T124 Tannery sludge as a nutrient source for the tropical grass *Brachiaria brizantha*. C. H. B. Miranda*^{1,2}, ¹*Embrapa Labex USA, Lincoln, NE*, ²*Embrapa Beef Cattle, Campo Grande, MS, Brazil.*

A field study was conducted to determine the potential value of tannery sludge as nutrient source for *Brachiaria brizantha* cv. Marandu. Five different rates (0, 1.65, 3.3, 6.6 and 13.2 Mg/ha) of air-dried (final moisture of 40%) and ground (2 mm sieve) sludge were applied to a pasture established in a Red Latosol soil in Campo Grande, Brazil. Sludge was from a tannery plant that recycles water and Cr during the first processing stages. Its nutrient content was (%) 13.3 Ca, 2.9 N, 0.52 P, 0.1 K, 4.6 Na, and 0.38 Cr. A control treatment with chemical fertilizer (2 Mg/ha of Ca, and 100 kg/ha of N, P and K, respectively) was also included. Treatments were distributed in a completely randomized block design, with 5 replications (a field plot 5m x4 m wide), and applied after cutting and removing the cut biomass. Re-growth material was cut 10 cm above ground 45, 90, 270 and 360 d later and analyzed for total dry mass production, plant quality (IVDMD, ADF, ADL, NDF, crude protein and lignin), and P, K, Ca, Mg, S, and Cr contents. Soil samples (0 to 20 cm depth) were collected before sludge application, and also a year later, and they were analyzed for Ca, P, K, pH and conductivity. Overall, forage yield was significantly higher ($P < 0.05$) in the rates of 6.6 and 13.2 Mg/ha of sludge (2.4 and 3.1 Mg/ha, respectively) than in the control without sludge amendment (1.6 Mg/ha), but significantly lower ($P > 0.05$) than that produced in the chemical fertilizer treatment (3.6 Mg/ha). There was increase in soil Ca contents in these sludge treatments (0.75 and 1.05 cmol/dm³, respectively) compared with the control soil (0.4 cmol/dm³), but not of P (average 0.49 mg/dm³) or K content (average 0.08 cmol/dm³). No significant differences ($P > 0.05$) in plant Cr content nor of soil conductivity were observed. Thus, it can be concluded that tannery sludge can be a good source of Ca, but it is a poor source of P and K. Further monitoring of Cr chemistry in the plant and in the soil is needed to assure the use of these sludge materials.

Key Words: agrindustrial residues, plant nutrition, forage

T125 Absorption and utilization of nitrogen by *Panicum maximum* cv. Massai. C. H. B. Miranda*^{1,2}, ¹*Embrapa Labex USA, Lincoln, NE*, ²*Embrapa Beef Cattle, Campo Grande, MS, Brazil.*

An experiment was conducted to determine the response of *Panicum maximum* cv. Massai, a tropical forage grass, to increasing levels of N fertilizer and harvest date. This is a new variety, suitable for cattle, horses and sheep, that shows some quality constraints, which may be alleviated with proper N management. Treatments consisted of 4 N rates (0, 50, 100

and 200 kg N/ha), supplied as ammonium nitrate, and 5 harvest dates (21, 28, 35, 42, and 49 d after planting - DAP). A set of 20 replications was prepared for each treatment, distributed in a complete factorial experimental design, with 4 replications per treatment. Each replication was a pot with 4 kg of a Quartz-sandy soil, typical of the Brazilian Cerrados (savannah-like area), base of the beef cattle industry in the country. Nitrogen rates were applied a week before the transplanting of 4 seedlings per pot. The experiment was conducted in a greenhouse. Soil moisture was kept constant at 80% of soil field capacity throughout the experimental period. At every harvest date 4 replications per treatment were collected, and roots and above ground dry mass was separated, dried at 72°C for 72 h, weighed, and grounded, being analyzed for N content using Near Infrared Spectroscopy. ANOVA of the experimental results showed that there were significant effects ($P < 0.01$) of N rates, harvest date, and their interaction, for above-ground and roots dry mass and N accumulation. Plant yield within the harvests dates followed a polynomial quadratic pattern, with N uptake increasing up to 42 DAP, and dry matter accumulation increasing up to 49 DAP. On average, the efficiency of N utilization was around 4 mg of dry mass per mg of N taken per day. Further evaluations on plant quality are necessary to conclude which would be the best combination of N rate and harvest date for this forage grass.

Key Words: plant nutrition, tropical grasses, forage

T126 Comparisons among predictive equations and NIR for determination of in vitro indigestible NDF of corn silages. R. Ward^{*1}, S. Weaver¹, and R. A. Patton², ¹Cumberland Valley Analytical Services, Maugansville, MD, ²Nittany Dairy Nutrition, Mifflinburg, PA.

An investigation was undertaken to assess the accuracy of NIR or equations based on analyzed nutrient content to predict in vitro indigestible NDF (INDF). A data set of 115 corn silages with indigestible NDF determined by 120 h Tilley and Terry incubations was developed. For application of equations based on forage type, silages were classified as BMR ($n = 18$, mean lignin = 2.06% DM), MED ($n = 62$, mean lignin = 2.81), and HI ($n = 25$, mean lignin = 3.51). Using this data, chemically determined INDF was compared against equations developed from a smaller data set by Proc Reg of SAS using the stepwise selection. Predictive equations were based on all corn silage types (general equation), individual corn silage type as well as calculation of INDF as lignin*2.4. The Mean Square Predicted Error statistic of Bibby and Toutenburg was used to compare predictions with observed values. The general equation was $INDF = 2.065 + (1.378 * \text{soluble protein \%DM}) - (0.352 * \text{NDF \%DM}) + (6.128 * \text{lignin \%DM})$, $R^2 = 0.98$. For BMR, the equation was $INDF = (28.985 - (6.272 * \text{fat \%DM}))$, $R^2 = 0.99$; MED was $INDF = (1.838 * \text{ADF}) - 36.688$, $R^2 = 0.99$; and HI was $INDF = 12.285 - (1.550 * \text{Ash \%DM})$, $R^2 = 0.99$. Forcing equations based on lignin and/or lignified NDF content resulted in no significant equations for BMR or HI corn silage. However, a general equation was better than feed type specific equations. Residual analysis indicated that as lignin content increases, feed type specific and lignin*2.4 equations become less accurate, while the general equation continues to perform satisfactorily. We conclude that NIR is a better predictor of INDF than equations and that for corn silages, a general equation is better than feed specific equations.

Table 1.

Model	Std		%		Error Due To		Random
	Mean	Dev	RMSPE	Mean	Bias	Regression	
Observed	12.55	2.12	—	—	—	—	—
NIR	12.50	1.93	0.83	6.6	0.4	0.1	99.5
Feed							
Specific	7.80	4.06	6.71	53.4	50.1	40.1	9.8
General	10.90	3.30	3.25	25.9	25.8	44.0	30.2
Lignin*2.4	6.97	1.32	5.75	45.8	94.3	0.3	5.4

Key Words: corn silage, NIR, INDF

T127 Nitrogen lixiviation and uptake by forage maize with different fertilization and previous soil use. R. D. Améndola-Massiotti^{*1}, I. Cach-Gómez¹, M. E. Álvarez-Sánchez¹, J. A. Burgueño-Ferreira², and I. López-Cruz¹, ¹Universidad Autónoma Chapingo, Chapingo, México, ²Colegio de Postgraduados, Montecillo, México.

In crop rotations of forage maize (*Zea mays*) and pastures, nitrogen (N) content of the soil declines during the maize crop. The present study was carried out at Chapingo (central temperate Mexico). The aim was to estimate the effect of 3 N rates (NF) in combination with 3 previous soil uses (SU, representing possible phases in the rotation) on the amount of N harvested with a forage maize crop and lost by lixiviation during that crop. Nine treatments were evaluated, combining NF: 0 (N0), 100 (N100) and 200 (N200) kg N/ha and SU: 3.5 years of permanent *Medicago sativa* and *Dactylis glomerata* pasture (P); 3.0 years of permanent pasture and 6.0 mo of annual *Avena sativa* and *Lolium multiflorum* pasture (PA); and 2.5 years of permanent pasture, 6.0 mo of forage maize crop and 6.0 mo of annual pasture (PMA). A randomized complete block split-plot design with 3 replicates was used; SU was assigned to whole units and NF to sub-units of 54 m². Response variables were N-uptake by the crop, N lixiviation (not measured at N0 treatments) and total N content of the soil at 2 depths, 0–30 and 30–60 cm. Analysis was performed using a mixed model and means were compared using orthogonal contrasts. The NF had a linear effect ($P < 0.05$) on N-uptake (274 ± 15 kg N/ha at N0, 44.9% lower than at N200) and lixiviation (98 ± 19 kg N/ha at N100, 73% lower than at N200); SU did not affect ($P > 0.05$) those variables. The N content in the top soil layer decreased ($P < 0.05$) with increasing time of annual crops (5461, 5095 and 4685 kg N/ha for P, PA and PMA), and it was higher ($P < 0.05$) in the 0–30 layer (5080 kg N/ha) than in the 30–60 layer (3437 kg N/ha). Average N content of soil decreased ($P < 0.05$) in 775 kg N/ha during the maize crop, due to N harvest, lixiviation and not measured gaseous losses. It is concluded that efficient N management is needed to reduce N losses during the forage maize phase of the rotation.

Key Words: pastures, alfalfa, soil nitrogen

T128 Biological nitrogen fixation in the tropical forage legume Stylo. C. H. B. Miranda^{*1,2}, J. R. Verzignassi², and C. D. Fernandes², ¹Embrapa Labex USA, Lincoln, NE, ²Embrapa Beef Cattle, Campo Grande, MS, Brazil.

The forage legume *Stylosanthes* spp. is an excellent forage legume alternative for tropical areas because of its adaptation to acidic, low fertility soils, and, especially, because of its biological nitrogen fixation (BNF) potential. We compared dry mass production, total N content, and BNF of 4 field grown advanced genotypes of both *S. capitata* and *S. guianensis* taken from a breeding program being conducted at

Embrapa Beef Cattle, in Brazil, with the objective of selecting materials that represent increased BNF potential through symbiosis with native soil N-fixing bacteria. BNF was evaluated by comparison of their ^{15}N isotope natural abundance content and that of 5 non-fixing plants species naturally growing among them (^{15}N isotope dilution technique). Genotypes were planted in a randomized block experimental design, with 4 replications, in a Dark Red Latosol, without inoculation with N-fixing bacteria. Three hundred kg/ha of 0–20–20 NPK were applied at planting and re-applied a year later, after a full harvest. Evaluation of second year biomass production, harvested at seed grain filling stage, indicated that genotypes of *S. capitata* produced ($P < 0.05$) more dry biomass (ranging from 14 to 16 Mg/ha, average 14.9 Mg/ha) than those of *S. guianensis* (9.8 to 13.1 Mg/ha, average 11.5 Mg/ha). They also showed larger ($P < 0.05$) N content (average 256 kg/ha, compared with 238 kg/ha), from which an average 65% (or 167 kg of N/ha) was originated from BNF, compared with 33% in *S. guianensis* (or 85 kg/ha). Such BNF may result in a significant contribution to quality improvement and maintenance of mixed tropical pastures, either by direct contribution as feed or as organic material that would add N to the soil. We conclude that *S. capitata* genotypes have high BNF potential and should be prioritized in a new variety selection program.

Key Words: pasture sustainability, plant biomass, plant nutrition

T129 Yield and quality of two tropical leguminous trees in the establishment year. E. Cortes-Diaz*, F. Amador-Solano, G. T. Gonzalez-Bonilla, J. L. Zaragoza-Ramirez, and P. Martinez-Hernandez, *Animal Science Department, University of Chapingo, Texcoco, Mexico.*

Leguminous trees planted into tropical grass-pastures can increase forage yield and quality offered to grazing sheep. The aim of the study was to determine forage yield and quality of *Leucaena leucocephala* cv. Cunningham (improved and introduced tree species) and *L. collinsii* (native tree species) in the establishment year and forage yield of the associated grass (*Brachiaria brizantha* cv. Libertad). Treatments were arranged in a 2×3 factorial: 2 leguminous trees, and 3 densities: 5000 (high), 3333 (medium) and 2500 (low) plants/ha; in a completely random design with 3 replications, experimental unit was a 256 m² plot. Tree seeds were grown in a nursery for 4 mo, then transplanted in early summer (rainy season) into a year-before established grass pasture, planting was in rows 2 m apart and with 1, 1.5 and 2 m between plants within a row to achieve high, medium and low densities, respectively. At the time of planting grass was cut to a 5 cm stubble. Three harvests to determine yield and quality were done before the onset of dormancy season, these were at 47, 83 and 206 d after transplant and after each harvest ewe-lambs grazed all plots to leave a 5 cm grass stubble. Season yields and mean crude protein concentrations were analyzed. Statistical analysis was with a model for a factorial arrangement and 3 replications. Grass yield was 4909 kg DM/ha and similar ($P > 0.05$) across factors. *L. collinsii* gave 36 and 4.9 kg DM and CP/ha, respectively which were 2.6 and 1.8 times higher ($P < 0.05$) than in *L. leucocephala*, this last species showed 20.9% CP, 6 percent units higher ($P < 0.05$) than *L. collinsii*. It was concluded that in the establishment year tree density has no effect on any component while tree forage yield and quality can be different between species.

Key Words: *Leucaena leucocephala*, *Leucaena collinsii*, fodder trees

T130 Sequence similarities of genes from the lignin biosynthesis pathway in tropical grasses, maize and rice. D. M. Gerônimo, N. S. Oliveira, A. B. S. Machado, and L. F. P. Silva*, *Universidade de São Paulo, Pirassununga, SP, Brazil.*

Rapid decline in cell wall digestibility, due to lignifications, hinders efficient use of warm-season grasses. The objective was to partially sequence transcripts of the main enzymes involved in monolignol synthesis to determine similarity among tropical grasses, and other with more advanced genomic resources (maize and rice). Total RNA was isolated from bermudagrass (*Cynodon dactylon* L. Pers. cv. Coastcross-1), and palisade grass (*Brachiaria brizantha* A. Rich. cv. Marandu) and treated with DNase 1. Degenerated oligonucleotide primers for glyceraldehyde-3-phosphate dehydrogenase (GAPDH), 4-coumarate-CoA ligase (4CL), cinnamate-4-hydroxylase (C4H), cinnamoyl-CoA-reductase (CCR), caffeic acid O-methyltransferase (COMT), and phenylalanine ammonia lyase (PAL) were designed based on conserved regions of maize, rice and guineagrass. Treated RNA was reverse transcribed and amplified with PCR, and PCR products were purified and sequenced in both directions. Quality and alignment of sequences were obtained using Phred and Cap3 softwares. Obtained sequences were compared using the BLAST program. There was a high degree of similarity between all grasses. Palisade grass and bermudagrass had overall nucleotide sequence similarity with maize of 94.2 and 93.8, respectively; and aminoacid sequence similarity of 96 and 88%, respectively. Comparing with rice sequence, palisade grass and bermudagrass had overall sequence similarity of 87.4 and 87.2, respectively; and aminoacid sequence similarity of 88 and 90.7%, respectively. Both tropical grasses had higher nucleotide and aminoacid sequence similarity with maize than with rice, indicating that maize genomic resources could be used for gene expression studies in these tropical grasses.

Table 1. Similarity among nucleotide and aminoacid sequence of tropical grasses, maize and rice

Grasses	Genes	Nucleotide, %		Aminoacid, %	
		Maize	Rice	Maize	Rice
Palisade grass	GAPDH	91	88	92	90
	4CL	—	—	—	—
	C4H	96	91	98	88
	CCR	95	77	96	81
	COMT	96	90	100	89
	PAL	93	91	94	92
	Bermuda grass	GAPDH	91	87	96
Bermuda grass	4CL	93	89	95	91
	C4H	94	89	93	86
	CCR	94	76	96	80
	COMT	96	90	98	95
	PAL	95	92	98	100

Key Words: *Brachiaria brizantha*, *Cynodon dactylon*, DNA sequencing

T131 Ovine and caprine in vitro digestibility of *Peganum harmala*. L. N. Tracey*, L. B. Abbott, J. Browne-Silva, and S. L. Lodge-Ivey, *New Mexico State University, Las Cruces.*

The possibility of using small ruminants to reduce African rue (*Peganum harmala*; AR) on New Mexico rangelands is being evaluated. African rue is known to be toxic to guinea pigs, cattle and sheep; however, toxicity has not been documented in goats. The objective of this study was to examine the IVDMD and rumen fermentation of AR by sheep and goats in vitro. A completely randomized experimental design with a 2×4 factorial arrangement of treatments was used. Factors included ruminal fluid donated from sheep vs goats and 4 levels of AR:Sudan hay (0:100, 25:75, 50:50, 100:0; n = 8; DM basis) as substrate for a 48-h

Tilley-Terry in vitro digestion trial. Significant treatment (trt) by species interactions were observed for IVDMD and 48-h VFA concentrations ($P < 0.05$). Increasing levels of AR increased IVDMD for both sheep and goats ($P = 0.005$). However, when 50:50 was added goat IVDMD was 5.56% greater than sheep ($P = 0.03$). Sheep IVDMD was 5.72% greater than goat when 100:0 was digested ($P = 0.01$). Total VFA production varied by trt and species ($P < 0.001$) with sheep 0:100 and goat 25:75 resulting in the greatest total VFA production (198.5 and 192.3 mM, respectively). Digest of 100:0 resulted in the least total VFA with goat being the lowest at 131.1 mM. Acetate levels were highest in goat digests of 100:0 which was 23.0% greater than the lowest concentration (sheep 50:50). Propionate concentrations differed in both species except in the 50:50 concentration ($P = 0.76$). The acetate:propionate ratio differed in both species at each AR concentration ($P < 0.05$) with the greatest variation existing at 100:0 digest where A:P ratio was 48.4% higher in the goat digest than in sheep. Overall increase in digestibility with increasing AR concentration and VFA results suggest that rumen microbial activity is undiminished at 50:50 or less AR in small ruminants. Additional in vivo research is needed to determine the potential to control AR using targeted grazing with small ruminants.

Key Words: *Peganum harmala*, ovine, caprine

T132 Chemical composition and in vitro ruminal fermentation activity of three Mexican browse species during dry season. D. López, R. Rojo*, A. Z. M. Salem, J. L. Tinoco, J. F. Vázquez, B. Albarrán, F. González, and D. Cardoso, *Centro Universitario UAEM-Temascaltepec, Temascaltepec, Estado de México, México.*

Browse foliage from *Pithecellobium dulce*, *Heliocarpus velutinus* and *Guazuma ulmifolia* natives to the subtropical region of southern Mexico, were harvested during the dry season to determine chemical composition and some parameters of ruminal fermentation using ruminal inoculum of goats. Crude protein, NDFom, ADFom, in vitro gas production after 24 (GP₂₄), 48 (GP₄₈) and 96h (GP₉₆) of fermentation, IVDMD and IVOMD were determined while ME was estimated. Data were analyzed using the general lineal model (GLM) procedure in SAS for a completely randomized design and differences among means by Tukey test. Crude protein (*P. dulce*: 222.10, *H. velutinus*: 154.30 and *G. ulmifolia*: 147.76 g/kg) values were different among browse species ($P < 0.01$). *P. dulce* had the lowest NDFom: 435.22; and ADFom: 305.79), *H. velutinus* showed intermediate values (NDFom: 455.80 and ADFom: 323.57) and *G. ulmifolia* had the highest values (NDFom: 478.06 and ADFom: 368.46) g/kg. In vitro gas production, IVDMD, IVOMD and ME values varied among browse species ($P < 0.001$) (Table 1). *P. dulce* has the highest potential as a feed protein source in small ruminants during the dry period.

Table 1. In vitro ruminal fermentation parameters (g/kg DM) of some browse tree leaves

Parameters	<i>P. dulce</i>	<i>H. velutinus</i>	<i>G. ulmifolia</i>	SEM	P-value
GP ₂₄	90.2 ^a	69.5 ^b	34.2 ^c	8.2	<0.01
GP ₄₈	153.3 ^a	129.3 ^b	81.0 ^c	10.7	<0.01
GP ₉₆	184.3 ^a	156.8 ^b	124.6 ^c	8.6	<0.01
IVDMD	526.0 ^a	528.5 ^{ba}	460.2 ^b	11.6	<0.04
IVOMD	559.9 ^a	534.9 ^a	464.6 ^c	14.4	<0.01
ME (MJ/kg DM)	9.60 ^a	7.81 ^b	5.37 ^c	0.62	<0.01

Means in the same row with different superscripts differ ($P < 0.05$). (GP) Gas production after 24, 48 and 96 h of fermentation (mL/g DM).

Key Words: browse species, chemical composition, ruminal fermentation

T133 Effect of forage species on ruminal fermentation in continuous culture. K. J. Soder*, M. A. Sanderson¹, and G. E. Brink², ¹USDA-ARS, University Park, PA, ²US Dairy Forage Research Center, Madison, WI.

The objective of this experiment was to evaluate the effects of forage grass species on ruminal fermentation using a dual-flow continuous culture fermenter system. Four grass species [reed canarygrass (RCG, *Phalaris arundinacea* L.); quackgrass (QG, *Elytrigia repens*); orchardgrass (OG, *Dactylis glomerata* L.); and meadow fescue (MF, *Festuca pratensis* Hud.)] were compared in a 4 × 4 Latin square design. Four 10-d periods were conducted, using the first 7 d as adaptation and the last 3 d for sampling. Fermenters (1120–1140 mL in volume) were fed 11.25 g forage DM 4 times daily at 0700, 1030, 1430 and 2030 h. A corn-based supplement (8.7% CP, 10.6% NDF) was fed (15 g DM) twice daily at 0700 and 1430 h. Solids retention time was set at 24 h. The pH was measured at each feeding time. Fermenter effluent were collected at 1430 h on d 8 to 10 and subsampled for analyses of VFA, ammonia, and DM content. Fermenter contents were harvested on d 10 for analyses of DM and bacterial production. Apparent DM, OM, and NDF digestibilities were not affected ($P > 0.05$) by forage species, averaging 39.2, 42.6 and 77.0%, respectively, across all forage species. Apparent ADF digestibility was least ($P < 0.05$) for QG (53.5%). The pH was not affected ($P > 0.05$) by forage species, averaging 6.21 across all forage species. Total and individual VFA production and acetate to propionate ratio (A:P) were not affected ($P > 0.05$) by forage species with the exceptions of isobutyrate, which was greatest ($P < 0.05$) for OG, and isovalerate, which was least ($P < 0.05$) for MF. Ammonia production was greatest ($P < 0.05$) for QG and least for MF. Total N and ammonia flows (expressed as g/d) were greatest ($P < 0.05$) for QG and least for MF. Efficiency of bacterial protein synthesis (gN/kd DM truly digested) was greatest ($P < 0.05$) for RCG and QG. The impact of individual forage species on ruminal fermentation is critical to gaining a better understanding of digestive and ingestive behavior for improved pasture management recommendations.

Key Words: canopy structure, digestibility, forage species

T134 Yield, chemical composition and ruminal degradability of winter wheat grown under organic and conventional management. I. Mateos¹, M. J. Ranilla^{1,2}, A. Diaz¹, C. Palacios¹, C. Saro^{1,2}, M. L. Tejido^{1,2}, and M. D. Carro*^{1,2}, ¹Dept. Producción Animal, Universidad de León, 24007 León, Spain, ²Instituto de Ganadería de Montaña (CSIC-ULE), Finca Marzanas, 24346 Grulleros, León, Spain.

The objective of this study was to investigate differences in yield and nutritive value of organically and conventionally grown winter wheat crops. Each cultivation system was carried out in 3 plots bordering each other to assure similar soil properties. Whole-plant (WP) yield was determined in May 2009, and grain and straw yields were determined at maturity in July 2009. Samples were dried and chemical composition and in vitro dry matter digestibility were determined. Samples (500 mg) of each substrate were incubated with 50 mL of buffered rumen fluid at 39°C, and gas production was measured at 3, 6, 9, 12, 16, 21, 26, 31, 36, 48, 60, 72, 96, 120 and 144 h to estimate fermentation kinetics. Mean yield in conventional plots was 3.12, 1.28 and 1.06 t DM/ha for WP, grain and straw, respectively. Organic cultivation decreased the yield of WP, grain and straw to 74, 57 and 76% of that in the conventional cultivation, respectively ($P > 0.24$). No differences ($P > 0.05$) in organic matter, neutral detergent fiber and acid detergent fiber content of WP or grain were detected between cultivation systems, but crude protein content was lower ($P < 0.01$) in organic compared with conventional cultivars (6.69 vs. 5.23% for WP, and 12.10 vs. 8.56% for grain). No

differences ($P > 0.05$) between cultivars were detected in chemical composition of straw. Organic and conventionally grown crops did not differ ($P > 0.11$) in their in vitro dry matter digestibility (43.6 vs. 45.2% for WP, 26.3 vs. 24.8% for straw and 79.6 vs. 78.2% for grains). The cultivation method did not affect ($P > 0.26$) either the potential gas

production or the average production rate (calculated as mL of gas/h). The results indicate that organic cultivation reduced crop yield and protein content in WP and wheat grains, but no effects were observed on ruminal degradation.

Key Words: organic cultivation, winter wheat, gas production