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Forages and Pastures: General forages and forage systems

W158 Chemical composition, digestibility and fermentation characteristics of sorghum ensiled with soybean crop residue.

Larissa de A. Lima, Marcia Dias, Nayara D. de Carvalho, Vinicio A. Nascimento, Vera L. Banys, and Edgar A. Collao-Saenz*, *Universidade Federal de Goiás, Jataí, GO, Brazil.*

The fermentation of silage process depends on the initial balance of nutrients in the ensiled forage and must minimize nutritional losses. Agricultural regions have high quantities of crop residues, and sometimes these residues have nutritional value and are used as co-products like soybean hulls but stalks, leaves and broken grains are frequently lost. The objective of this assay was to evaluate the effects of the soybean crop residue inclusion (0, 3 and 6% as fed basis) on sorghum silage quality. Sorghum was harvested at 30% dry matter (DM), mixed with the residues and ensiled targeting density between 600 and 650 kg as fed/m³ using 6 silos/treatment. The nutritional value was evaluated after 50 d of ensiling. There was a significant effect of the soybean residue inclusion for crude protein (CP) (5.59, 6.50 and 6.74% DM), and neutral detergent insoluble protein (NDIP)/CP (42.46, 35.24 and 32.60%). The soybean residue inclusion reduced the non-fiber carbohydrates (34.51, 31.77 and 29.93% DM) and total carbohydrates (85.84, 84.84 and 83.79% DM) which caused decreases in in vitro DM digestibility (63.49, 63.35 and 59.71%) and in vitro OM digestibility (65.77, 61.64 and 59.05%). Linear increase in gas production (75.50, 101.62 and 129.22 mm³/gDM/h) was observed. The pH close to 3.8 at the moment of opening the silo, the constant ammonia-N concentration (72.8 g/kg total N), and the high recovery of DM 86.87% and OM 85.74% indicate heterolactic fermentation favoring acetic acid production which promotes aerobic stability of silage. An inclusion of soybean crop residue up to 6% as fed basis in sorghum silage is possible without effects on the fermentation characteristics of the silage.

Key Words: gas production, pH, silage

W159 Effect of reduced lignin alfalfa on forage quality at three harvest intervals. Zhiqiang Li*², Zhenzhen Li², David Combs¹, and Daniel Undersander¹, ¹University of Wisconsin, Madison, WI, ²China Agricultural University, Beijing, China.

The present study investigates the effect of reduced lignin on alfalfa quality. Two alfalfa cultivars [Roundup Ready (RR) and double stacked Roundup Ready and Reduced Lignin (RR/RL)] were harvested at intervals of 28, 33, and 35 d. All replicated plots were harvested for 2 regrowth periods in July and August, 2014. CP, aNDF, lignin, NDFD48 value of samples on DM basis were analyzed with NIRS method (FOSS 6500) using NIRSC 2012 Alfalfa Hay Equation. Statistical analysis was done as a 2 way ANOVA using SPSS 22. CP content was not different between RR and RR/RL (27.5 vs 28.0, $P > 0.05$) and declined with advancing maturity ($P < 0.05$). aNDF content was higher in RR than RR/RL (31.6 vs 30.1, $P < 0.05$) though differences among harvest intervals were not significant (30.8 vs 30.5 vs 31.1, $P > 0.05$). Lignin content was not significantly different between RR and RR/RL (5.6 vs 5.5, $P > 0.05$) or among harvest intervals (5.6 vs 5.6 vs 5.5, $P > 0.05$). The NDFD48 of RR/RL was significantly higher than RR (52.2 vs 50.5, $P < 0.05$) and that of 28d harvest interval was significantly higher than 33d and 35d levels (53.1 vs 50.2 vs 50.8, $P < 0.05$). No significant interaction occurred between variety and harvest interval for any of the above 5 indices. The iNDF, kd and total-tract NDF digestibility (TTNDFD) are shown in the table below. The reduced lignin alfalfa tended to be lower

in iNDF and higher in kd though differences were not significant, but was significantly higher in TTNDFD ($P < 0.012$). It appears that RR/RL variety reduces the NDF content and improves NDFD48, and TTNDFD.

Table 1 (Abstr. W159).

Item	Interval	RR	RR/RL	Mean	P-value		
					Forage	Forage harvest interval	Forage harvest × interval
iNDF	28d	34.1	29.9	31.7 ^b	0.086	0.001	0.470
	33d	42.1	37.0	39.9 ^a			
	35d	39.3	39.2	39.2 ^a			
	average	38.7 ^a	35.1 ^a	36.8			
Kd	28d	7.8	7.1	7.4 ^a	0.156	0.980	0.153
	33d	7.0	8.2	7.5 ^a			
	35d	6.4	8.9	7.8 ^a			
	average	7.0 ^a	8.0 ^a	7.6			
TTNDFD	28d	53.0	56.3	54.9 ^a	0.012	0.010	0.849
	33d	46.3	51.9	48.7 ^b			
	35d	46.8	51.1	49.2 ^b			
	average	48.6 ^b	53.3 ^a	51.0			

^{abc}Means in rows or columns with different superscripts differ ($P < 0.05$).

Key Words: alfalfa, lignin, forage

W160 Characterization of novel polymers for alkaloid

adsorption. Manoj B. Kudupojee*^{1,2}, Eric S. Vanzant¹, Alexandros Yiannikouris², Karl A. Dawson², and Kyle R. McLeod¹, ¹University of Kentucky, Alltech-University of Kentucky Research Alliance, Lexington, KY, ²Center for Animal Nutrigenomics & Applied Animal Nutrition, Alltech Inc., Nicholasville, KY.

A methacrylic acid-based molecularly imprinted polymer (MIP) was evaluated for physical and isothermal adsorption properties. Polymers were synthesized by suspension polymerization with (MIP) or without (NIP) ergotamine tartrate (ETA) as template. Polymer morphology was characterized by light scattering diffraction, SEM and BET. Polymer-template interactions were characterized by FT-IR, ¹H NMR and isotherms. For each of 4 alkaloids evaluated, adsorption difference between MIP and NIP interacted ($P < 0.01$) with alkaloid concentration, but product differences were generally consistent across concentrations. With bromocryptine and methylergonovine, average adsorption was greater ($P < 0.01$) for MIP than NIP (62.9 vs 37.1 and 35.8 vs 24.7%, respectively). NIP adsorption was greater ($P < 0.01$) for ETA (93.1 vs 96.7%), and no difference ($P > 0.05$) existed between products for lysergol adsorption (38.1 vs 37.7). The Freundlich model ($R^2 = 0.99$) indicated similar adsorption intensity to ETA for MIP ($n \sim 1.025$) and NIP ($n \sim 1.011$) and the Qmax estimate from the Langmuir model ($R^2 = 0.99$) was 388.7 and 435.4 nM/mg for MIP and NIP, respectively. Both polymers had IR spectra at ~3500 (carboxyl stretch), ~1730 (carbonyl stretch), and ~1260 cm⁻¹ (C-O stretch) indicating similarities in backbone structure. Spectral shifts observed in polymer-ETA complex samples suggest the interaction with amine groups was via H-bonding, which was confirmed using ¹H NMR. SEM demonstrated compactness of implanted polymer, which, after template removal turned microporous with microvoids. BET analysis showed NIPs to have a smooth surface with few pore structures, whereas MIPs exhibited greater surface area

resources for livestock feed. Shrub is seldom used as material to make silage as legumes are often considered hard to ensile well due to low fermentable carbohydrate content in combination with a high buffering capacity (BC). Whole-crop corn is ascribed to easy ensiling procedure and has high fermentative quality and palatability for cows, because of the chemical composition of corn, mainly in high fermentable carbohydrates. Silage produced from a mixture of whole-crop corn and 2 kinds of shrub is likely to have a better fermentation quality and nutritive value compared with silage consisting solely of herbage from RB and SS. RB and SS (315 and 274 g dry matter per kg) were cut into 2 to 5 cm by a rubbing filament machine and ensiled in 1.5 L laboratory silos with whole-crop corn as mixtures of 1, 0.7, 0.5, and 0.3 of fresh weight (FW). After 60 d, the nutrition and fermentation quality of all treatments were analyzed. Results showed that the pH of silage consisting solely of herbage from RB and SS were significantly ($P < 0.05$) higher and the lactic acid content were significantly ($P < 0.05$) lower than silages mixed with whole-crop corn. With the increase of the proportion of corn, lactic acid and acetic acid content also increased ($P < 0.05$). Dry matter and WSC content decreased with the increase of the proportion of corn ($P < 0.05$). In conclusion, RB and SS with a high BC and a low WSC concentration is best ensiled using whole-crop corn. Inclusion of 0.5 to 0.7 of whole-crop corn is recommended to ensure a good fermentation.

Key Words: mixed silage, fermentation quality, shrub

W196 Late season forage yield, quality, and digestibility from mixed cropping of organic certified corn and soybean hybrids at different seeding rates. Ishwary Acharya* and David Casper, *Dairy Science Department, South Dakota State University, Brookings, SD.*

The production of forage resulting from the mixed cropping of corn and soybeans at planting has the potential to yield greater quantities of digestible nutrients to meet the nutrient requirements of lactating dairy cows. A field plot study was laid out using a completely randomized design to evaluate 2 organic corn hybrids [Normal (N) and MasterGraze (MG)] with 2 soybean hybrids [Regular (R) and Vining (V)] at 4 seeding rates (R1 = 65:35; R2 = 55:45; R3 = 45:55, and R4 = 35:65 of corn and soybean) having a 2 × 2 × 4 factorial treatment design replicated 3 times. Forage was hand harvested 93 d after planting during the 2014 growing season, inoculated, packed into buckets, weighed, and ensiled for 60 or 90 d. Buckets were then re-weighed, opened, and forage samples collected and submitted for nutrient analysis (Analab, Inc., Fulton, IL). Yield of DM (6.74 and 7.65 T/ha for N and MG, respectively) for main effect of corn was similar ($P > 0.05$), while V yielded greater ($P < 0.05$) than R (6.13 and 8.27 T/ha for R and V, respectively) for main effect of soybean, while seeding ratio main effect was similar [$(P > 0.05)$; 7.91, 6.29, 7.81, and 6.77 T/ha for R1, R2, R3, and R4, respectively]. Yield of fresh digestible DM (DDM; 4.40 and 5.06 T/ha) and CP (1.04 and 1.22 T/ha) were similar ($P > 0.05$) for corn, while V yielded greater ($P < 0.05$) DDM (4.03 and 5.43 T/ha) and CP (0.97 and 1.29 T/ha) than R and seeding ratios were similar ($P > 0.05$) in yield of DDM (5.20, 4.15, 5.08, and 4.50 T/ha) and CP (1.14, 1.05, 1.25, and 1.07 T/ha). A significant interaction ($P < 0.05$) was detected for corn × soybean × seeding ratio for ensiled DDM yield at 60 and 90 d, while no other significant ($P > 0.05$) interactions of main effects were detected. The combination of MG seed corn with V soybean hybrids at the ratio of 67:33 resulted in the greatest yield of DDM after 60 and 90 d of ensiling the forage. The mixed cropping of corn and soybeans holds great potential for increasing the production of forages to meet the nutrient requirements of lactating dairy cows.

Key Words: corn, soybean, yield

W197 Climatic and management factors affecting the forage yield and quality of a high density mulberry forage bank established under low input tropical farming conditions. Eliel González-García*² and Giraldo Martín-Martín¹, ¹*Estación Experimental de Pastos y Forrajes "Indio Hatuey," Matanzas, Cuba,* ²*INRA UMR868, Systèmes d'Élevage Méditerranéens et Tropicaux (SELMET), Montpellier Cedex 2, France.*

Effects of year season (SEAS), organic fertilization (N) and harvest frequency (FREQ) on forage yield and composition were evaluated in a high density mulberry forage bank, established under low input tropical farming conditions. The experiment, replicated 2 consecutive years, was arranged in 18 treatments resulting from a 3 × 3 × 2 factorial design combining 3 FREQ (60, 90 and 120 d), 3 N rates (100, 300 and 500 kg N/ha/year) and the 2 seasons (RAIN and DRY). Forage yield, leaf to stem ratio, the edible fraction (EDIB, %), nutrient content by plant fraction (PFR; i.e., leaves, tender and ligneous stems) and the maturity indexes were monitored. Either forage yield or nutrient content was strongly affected by SEAS, FREQ, PFR, N rate and, in some cases, by their interactions. Total forage yield increased ($P < 0.0001$) with FREQ (26.5, 31.2 and 40.6 t for 60, 90 and 120 d, respectively), irrespective of the SEAS (44.7 and 21.1 t for RAIN and DRY, respectively), PFR (19.2, 3.0 and 10.7 t for LEAF, TST and LST, respectively) or N (28.1, 32.0 and 38.5 t for 100, 300 and 500 kg N/ha/year, respectively). The EDIB yield was higher in RAIN (25.3 vs. 13.2 t; RAIN vs. DRY) and diminished while increasing FREQ, irrespective of SEAS or N. This decrease in EDIB yield was directly related to the decrease in the LEAF proportion and the concomitant increase of the LST fraction with FREQ. Harvesting at 60 and 90 d in RAIN and DRY, respectively, with a N rate of 300 kg N/ha/year seems the best agronomic choice as a most optimal condition between forage yield and nutritive value.

Key Words: forage yield and composition, harvest frequency, organic fertilization

W198 Response to using rumen inoculum from high and low feed efficient cows on in vitro fermentation of alfalfa ensiled with different additives. Francisco E. Contreras-Govea*¹, Richard E. Muck², Paul J. Weimer², and Ursula C. Hymes-Fecht², ¹*Department of Dairy Science, University of Wisconsin-Madison, Madison, WI,* ²*USDA-Dairy Forage Research Center, Madison, WI.*

Alfalfa from 2 consecutive harvests (H1, H2) was treated with *Lactobacillus plantarum* (LP, 10⁶ cfu/g alfalfa), formic acid (FA, 5.4 kg/Mg), and no additive (control), ensiled in mini-silos, fermented for 60-d at room temperature (22°C), and analyzed for nutritive value and fermentation profile. Silages were wet ground to a particle size of 2–3 mm using a food processor for in vitro true DM digestibility (IVTDMD). High (HE) and low efficient (LE) groups of 3 cannulated cows each were identified based on 2 lactations and had an average energy corrected milk/dry matter intake (ECM/DMI) ratio of 1.88 and 1.61, respectively. In each in vitro run, 12 silos from a harvest were analyzed simultaneously with 6 rumen inocula, one from each cow, for 24 h. Data analysis was conducted using the MIXED procedure of SAS, as a split plot design. For silage fermentation, harvest was the whole plot and alfalfa treatment as subplot. For the in vitro, HE and LE groups were main plot and treated alfalfa as sub-plot. In both cases mean differences were declared significant at $P < 0.05$. Across harvests, LP had lower pH (4.47) and greater lactic acid concentration (64.3 g/kg DM) than control (4.77, 52.1) and FA (4.70, 33.9). Moreover, ammonia-N was lower in LP (3.8% total N) and FA (4.2) than control (5.4) in both harvests. IVTDMD of the H1 silages was greater with the HE cows (79.6%) than LE cows (75.13%), but there was no difference at H2 ($P = 0.310$). The IVTDMD