
FORAGES AND PASTURES I: SILAGES

0304 Effect of corn silage hybrids differing in starch and NDF digestibility on lactation performance and total tract nutrient digestibility by dairy cows.

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The objective of this study was to determine the effect of feeding a TMR containing a floury-leafy corn silage hybrid (LFY) compared to a brown midrib corn silage hybrid (BMR) for intake, lactation performance and total tract nutrient digestibility in dairy cows. Ninety-six multiparous Holstein cows, 105 ± 31 DIM and 735 ± 18 kg of body weight at trial initiation, were stratified by DIM and randomly assigned to 12 pens of 8 cows each. Pens were randomly assigned to 1 of 2 treatments, BMR or LFY, in a completely-randomized design; a 2-wk covariate period with cows fed a common non-experimental diet followed by a 14-wk treatment period with cows fed their assigned treatment diet. Data were analyzed using Proc Mixed in SAS with covariate, treatment, period, and treatment \times period interaction as Fixed effects and pen within treatment as a Random effect. Starch digestibilities, in situ, in vitro and in vivo, were 10%, 6% and 5% units greater ($P < 0.05$), respectively, for LFY compared to BMR; however, the opposite was observed ($P < 0.05$) for NDF digestibility at wk 13 of treatment. Cows fed BMR consumed 1.7 kg/d more dry matter than LFY ($P < 0.01$); feed sorting was minimal and did not differ by treatment ($P > 0.10$). Although milk yield was greater ($P < 0.01$; 49.0 vs. 46.8 kg/d) and energy- and solids-corrected milk yields tended ($P < 0.10$) to be 1.5 kg/d greater for BMR than LFY, feed conversions (kg milk or component-corrected milk per kg DMI) did not differ ($P > 0.10$). Fat-corrected milk (50.3 kg/d on average) and milk fat yield (1.84 kg/d on average) were similar ($P > 0.10$), as milk fat content was greater ($P < 0.01$) for cows fed LFY (4.05%) than BMR (3.83%). Cows fed BMR had lower ($P < 0.001$) MUN concentration and greater ($P < 0.05$) milk protein and lactose yields compared to LFY. Body weight change and condition score were unaffected ($P > 0.10$) by treatment. Total tract starch digestibility was greater for cows fed the LFY corn silage, however, dry matter intake and milk and protein yields were greater for cows fed the BMR corn silage.

Key Words: corn silage, fiber, starch

0305 The interaction of drought stress and heat stress as determinant of dry matter yield and nutritional composition of corn whole-plant for silage.

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The objective of this study was to better understand how abiotic stresses affected DM yield and nutritional composition of corn whole-plant destined for silage. We analyzed data from corn hybrids performance trials completed at two sites over the 2011 and 2012 growing seasons within the state of Virginia. The first site is referred to as the Southern Piedmont region (Blackstone, VA). The second site is referred as Shenandoah Valley region (Lynnwood, VA). Data from eight corn hybrids (110 to 117 d to maturity) were tested in both sites and years. Dry matter yield and nutritional composition was analyzed through mixed model analysis, using hybrid as a fixed effect and site-year as a random effect (i.e., blocking factor). Climate data were obtained from weather stations located in Blackstone and Elkton, VA. Whole-plant DM yields did not differ between hybrids, but varied significantly across site-years. The extremely low DM yield observed for the Southern Piedmont region in 2012 (4556 kg/ha) is partially attributed to severe drought conditions (227 mm). However, substantially higher DM yields (12,678 kg/ha) were observed in the Shenandoah Valley region with only slightly more precipitations (262 mm) during the same year. Neutral detergent fiber concentrations did not differ among hybrids, but were significantly different between site-years. That NDF concentration in 2012 was much lower for the Shenandoah Valley region (43.0% NDF) than for the Southern Piedmont region (56.6% NDF) indicates that corn crops were affected differently despite summer drought. For year 2012, the Southern Piedmont region had maximum daily temperatures above 35°C for an extended period right after corn silking, whereas maximum daily temperatures were 7.1 ± 2.3 °C milder in the Shenandoah Valley region for the same corn crop stage. We concluded that heat stress had a major adverse effect on kernel development in the Southern Piedmont region, but not in the Shenandoah Valley region and that, therefore, heat stress exacerbated the effects of drought, reducing substantially DM yields and increasing whole plant fiber concentration. As an overall conclusion, low DM yields and poor quality of corn whole-plant for silage are beyond drought stress. Daily maximum temperatures should be considered when planning strategies to ensure good quality forage supply and reduce risk in dairy farming systems.

Key Words: corn, drought, heat, silking

0306 Effects of different levels of corn silage and alfalfa hay on rumen pH, VFA, and milk production in dairy cows.

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The present study investigated the effects of different levels of corn silage and alfalfa hay on rumen pH, VFA and milk production of Holstein cows. In this study 15 Holstein cows (39 ± 9 kg milk yield/day; 37 ± 10 d in milk) were used in a completely randomized design experiment. Animals were kept in individual tie-stalls for 9 wk. Treatments included three levels of hay and corn silage: 1) 10% alfalfa hay, 30% silage corn (CS); 2) 20% alfalfa hay, 20% silage corn (AH-CS); and 3) 30% alfalfa hay, 10% silage corn (AH), and the ratio of forage:concentrate was 60:40. Cows were fed the total mixed rations (TMR) twice daily. Individual DMI was measured daily. On 4 and 9 wk of experiment, rumen fluid from the ventral sac was sampled using the rumenocentesis technique. Rumen fluid samples were taken 4 h after morning feed. Rumen pH measured immediately after sampling using a pH meter. The rumen fluid was stabilized with sulfuric acid (1 cc per 50 mL) and frozen at -20°C until VFA analysis by gas chromatography. Normality of distribution and homogeneity of variance for residuals were tested using PROC UNIVARIATE and adjust Tukey-Kramer (SAS Institute, 2003). Dry matter intake was higher ($P < 0.05$) when cows were fed diets AH-CS (23.20 kg per day) and diet CS (22.95 kg per day) than diet AH (18.64 kg per day). Diet affected milk production with CS and AH-CS being higher ($P < 0.01$) than AH (34.88, 35.21 and 30.78 kg/day for diets CS, AH-CS and AH, respectively). Data from ruminal pH clearly showed replacing AH with CS had a quadratic effect on the rumen acidity ($P < 0.05$). In contrast to ruminal pH, ruminal VFA concentration was not meaningfully affected by the treatments ($P > 0.05$). It is concluded that feeding alfalfa hay more than corn silage reduced dry matter intake, therefore reduced milk production.

Key Words: alfalfa hay, corn silage, dry matter intake

0307 [Withdrawn]

0308 Effects of dairy slurry on the nutritive value and fermentation characteristics of alfalfa silages.

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Dairy producers frequently ask questions about the risks associated with applying dairy slurry onto growing alfalfa. Our objectives were to determine the effects of dairy-slurry application on the subsequent nutritive value and fermentation characteristics of alfalfa silages. Dairy slurry was applied to 0.17-ha plots of alfalfa; applications were made to the second and third cuttings during 2012 at mean rates of 42,437 ± 5505.6 L/ha and 41,729 ± 2503.5 L/ha, respectively. Four application strategies were evaluated. These included: i) no slurry; ii) slurry applied directly to stubble immediately after the preceding harvest; iii) slurry applied after 1 wk of regrowth; or iv) slurry applied after 2 wk of regrowth. All harvested forage was packaged in (0.9 × 0.9 × 1.8 m) large-rectangular bales that were ensiled as wrapped balage. Each bale was sampled on both a pre-ensiled (June or August 2012) and post-ensiled basis (May 2013). Yields of DM harvested from the second (2477 ± 175.8 kg/ha) and third (781 ± 73.9 kg/ha) cuttings were not affected ($P \geq 0.19$) by slurry application treatment. By May 2013, all silages appeared to be well-fermented, with no indication of undesirable odor. Only minor differences across manure application treatments were observed for post-storage nutritive value, as well as final pH, unfermented water-soluble carbohydrates, and starch. *Clostridium tyrobutyricum*, which is known to negatively affect cheese production, was not detected in any forage on either a pre- or post-ensiled basis. On a pre-ensiled basis, counts (log₁₀ genomic copies/g) for *Clostridium* Cluster 1 were greater for slurry-applied plots than for those not receiving slurry, and this response was consistent across the second (4.44 vs. 3.29; $P < 0.01$) and third cuttings (4.99 vs. 3.88; $P < 0.01$). Similar ($P < 0.01$) responses were observed on a post-ensiled basis; however, post-ensiled counts also were greater for delayed applications onto growing alfalfa compared with applications onto stubble for both the second (5.51 vs. 5.17; $P = 0.02$) and third (5.84 vs. 5.28; $P < 0.01$) cuttings. For the third cutting, counts also were greater following a 2-wk application delay compared to a 1-wk application delay (6.23 vs. 5.45; $P < 0.01$). These results suggest that the risk of secondary clostridial fermentations in alfalfa silages is greater following manure applications to alfalfa, and that applications to stubble are preferred (and less risky) compared to delayed applications onto growing alfalfa.

Key Words: alfalfa silage, clostridial fermentations, dairy slurry

0309 The effects of combination of lactic acid-producing bacteria and hydrolytic enzyme inoculants on ensiling characteristics of alfalfa and corn.

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Before ensiling, inoculants containing lactic acid-producing bacteria (LAB) may be used to promote greater, more rapid lactic acid production causing a faster pH decline, possibly resulting in less DM and nutrient loss. The inclusion of hydrolytic enzymes may increase simple carbohydrate availability, further increasing fermentation rate and pH decline. To test the effects of an inoculant containing four species of LAB and four hydrolytic enzymes, green chopped whole plant corn and alfalfa were treated with water (control) or with water containing the inoculant (treatment), resulting in forage that had 33% DM or 42% DM for corn and alfalfa, respectively. Each forage was packed into mini-silos (1206 cm³ volume; $n = 3$ /treatment per date) to monitor rate of fermentation. The pH was measured on d 1, 2, 3, 7, 13, 17, 21, 28, 45 for alfalfa and on d 1, 2, 3, 7, 10, 17, 28, 45 for corn. Data were analyzed using PROC NLIN and PROC MIXED of SAS significance declared when $\alpha = 0.05$. The rate of decline to terminal pH was faster ($P < 0.01$) in the treatment than control in alfalfa, but demonstrated no difference for corn ($P = 0.91$). Additionally, buckets ($n = 5$ per treatment; 21,504 cm³ volume) of each forage were ensiled to measure effect on nutrient composition (DM, CP, ammonia, starch in the corn, and sugar in the alfalfa) and pH after 59 d of fermentation. The pH of the treatment tended to be lower than control in alfalfa buckets ($P = 0.07$) on d 59 but did not differ between treatments in corn ($P = 0.92$). The percent DM and DM loss did not differ ($P > 0.5$) between treatments for either alfalfa or corn. The percent sugar and starch did not differ ($P > 0.58$) between treatments for alfalfa and corn, respectively. Crude protein content of alfalfa was lower ($P < 0.01$) in the treatment than control (13.3 vs. $13.0 \pm 0.06\%$) but did not differ ($P = 0.11$) between treatments in corn. Ammonia content did not differ ($P > 0.13$) between treatments for both alfalfa and corn. The inoculant appeared to affect the rate of decline to terminal pH in the alfalfa, but not corn, while having little to no effect on nutrient composition of either ensiled forage.

Key Words: silage, pH, inoculants

0310 In vitro digestibility and gas production kinetic characteristics of corn stover treated by calcium oxide and stored under anaerobic condition.

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As a large agricultural country, China is rich in corn stover resource. The nutritional value of corn stover can be improved

by calcium oxide (CaO) treatment. Anaerobic storage is an effective method to prevent the treated stover from molding. A 1 plus 3 × 3 design was used to investigate the effect of CaO level and moisture content on the in vitro organic matter disappearance (IVOMD) and gas production in 72h (GP_{72h}). Ground stover was treated with different levels of CaO (3%, 5%, and 7%) and moisture content (40%, 50%, and 60%). Untreated stover was used as control. Treated stover was kept under anaerobic condition for 15 d. Four Holstein cows with ruminal cannulas were used as animal donors of rumen fluid. An automated gas production system was used. Half gram of samples was added to each bottle (4 replicates/sample). Data were analyzed using single degree of freedom contrast to compare all the treatments with the control, and data excluding the control were further analyzed as a 3 × 3 factorial arrangement of treatments. There were no treatment interactions ($P > 0.01$), but differences ($P < 0.01$) were found for main effects of moisture and CaO on IVOMD. The CaO level affected ($P < 0.01$) GP_{72h}, but the moisture content and its interaction with CaO level had no effect ($P > 0.01$) on GP_{72h}. The rate, halftime, and AGPR (gas production rate when gas production is 1/2 of the maximum) of gas production were not affected ($P > 0.01$) by the moisture or CaO level. As CaO level increased from 3% to 7%, IVOMD increased from 45.36% to 52.66%. The combination of CaO level and moisture content that resulted in the highest IVOMD was 7% CaO at 50% moisture content. There were no significant differences ($P > 0.01$) in IVOMD between stover treated with 5% CaO at 50% or 60% moisture content and that treated with 7% CaO at 50% moisture content. Under 50% and 60% moisture content, the level of CaO above 5% was not able to further improve the IVOMD. When treated with 5% CaO at 60% moisture content, the IVOMD and GP_{72h} of corn stover can be improved by 25.94% and 13.91%. Based on this study, the level of 5% CaO at 50% or 60% moisture content seems to be the best treatment combination.

Key Words: corn stover; calcium oxide treatment; in vitro digestibility

0311 Effects of calcium oxide level and moisture content on the in situ degradability of the alkali treated and anaerobically stored corn stover.

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Corn stover is one of the most abundant agricultural residues in the world. Calcium oxide (CaO) treatment could improve the nutritional value of corn stover. Anaerobic storage is an effective way to keep the treated stover free from molding. The aim of this study was to investigate the in situ degradability of the corn stover treated with different combinations of CaO level and moisture content. Ground stover was treated with different levels of CaO (3%, 5% and 7%) and moisture

content (40%, 50% and 60%), then stored under anaerobic condition for 15 d. Four Holstein cows with ruminal cannulas were used to evaluate the in situ ruminal degradability of DM, OM, and NDF (ISDMD, ISOMD, and ISNDFD) of the corn stover. Stover samples were incubated in the rumen for 0, 4, 8, 12, 24, 36, 48, and 72h. Compared with untreated corn stover, CaO-treated corn stover had greater ($P < 0.01$) ISDMD, ISOMD, and ISNDFD. The moisture content and CaO level affected ($P < 0.01$) ISDMD, ISOMD, and ISNDFD, but no interaction of main effects existed. The greatest improvements in ISDMD, ISOMD, and ISNDFD occurred when stover was treated with 7% CaO and 60% moisture content; however, no differences ($P > 0.01$) in these in situ degradability parameters were observed between the stover treated with 5% CaO at 60% moisture content and that treated with 7% CaO at 60% moisture content. When treated with 5% CaO at 60% moisture content, the ISDMD, ISOMD, and ISNDFD of the stover were increased by 31.72%, 34.03%, and 36.50%, respectively. Based on this study, the level of 5% CaO and 60% moisture content was a proper treatment for corn stover.

Key Words: corn stover, calcium oxide, in situ degradability

0312 Effects of different silage forages on cecal fermentation in rabbits: In vitro gas production.

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The aim of this study was to evaluate the cecal fermentation of beans (*Phaseolus vulgaris*), faba beans (*Vicia faba*), common vetch (*Vicia sativa*), ryegrass (*Lolium perenne*), and barley (*Hordeum vulgare*) as silages in rabbits. In vitro gas production was performed using cecal contents from three rabbits (New Zealand, LW 2.5 k). Rabbits were fed forage silage and water ad libitum before cecal content collection. The rabbit's caeca

was emptied and pooled cecal contents were mixed before being used for in vitro cultures. Chemical composition of forage species was determined and samples were weighed (0.800 g of DM) in 125 mL flasks and incubated with 90 mL of solution and 10 mL of cecal content, which previously diluted (50:50 with buffer solution). Gas production (GP) was measured at 1, 2, 3, 4, 8, 10, 12, 24, 36, and 48 h in three runs of inoculations. GP was calculated (ml/g DM) to evaluate the differences between forage species. Data were analyzed as a completely randomized design with contrasts used to compare means, significance was declared at $P < 0.05$. Crude protein was greater ($P < 0.05$) in common vetch followed by faba beans and beans, than the other species. NDF and ADF contents were lower ($P < 0.05$) in beans and common vetch, ME and SCFA were greater ($P < 0.05$) in faba beans and ryegrass, and less in barley silage. In vitro GP (fraction B) was greater ($P < 0.05$) in rye grass and faba beans than the rest of the silages. Lag time has greater in common vetch ($P < 0.05$) than the rest of the silages. Results suggested that ensiling ryegrass or faba beans are suitable for rabbits feeding compared with barley forage.

Key Words: rabbits, cecal fermentation, in vitro gas production

Table 0312. Chemical composition (g/kg DM) and in vitro gas production (IVGP, ml gas/g DM) of forage silages species in rabbits

Item	Barley	Ryegrass	Beans	Common vetch	Faba beans	SEM	P-value
OM	969 ^{ab}	973 ^a	955 ^b	961 ^{ab}	965 ^{ab}	3.0	0.005
CP	46 ^d	139 ^c	146 ^{bc}	179 ^a	157 ^b	3.5	0.001
NDF	613 ^a	651 ^a	516 ^b	476 ^b	658 ^a	14.3	0.001
ADF	598 ^a	586 ^a	489 ^b	450 ^b	621 ^a	14.6	0.001
ADL	100 ^f	127 ^e	156 ^c	164 ^b	174 ^a	3.5	0.001
ME	10.3 ^c	20.0 ^a	16.6 ^b	17.3 ^b	20.3 ^a	0.5	0.001
SCFA	1.73 ^d	3.13 ^a	2.09 ^{cd}	1.99 ^{cd}	2.93 ^{ab}	0.12	0.001
IVGP							
B	87 ^b	121 ^a	88 ^b	90 ^b	119 ^a	5.3	0.001
C	0.0036 ^c	0.0236 ^a	0.008 ^{bc}	0.0113 ^{bc}	0.014 ^{abc}	0.002	0.001
Lag time	2.10 ^b	0.50 ^b	2.00 ^b	4.63 ^a	2.43 ^b	0.44	0.001