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Short communication: Production response of lactating dairy cows to brachytic forage sorghum silage compared with corn silage from first or second harvest

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ABSTRACT

A completely randomized lactation trial was conducted to compare the production response of lactating Holstein cows to diets based on corn or forage sorghum silage harvested from 2 crops. Corn was planted in March and harvested in July (corn silage-summer; CSS) and a second corn crop was planted in July and harvested in November (corn silage-fall; CSF). A brachytic dwarf brown midrib forage sorghum was planted in April, harvested in July (forage sorghum-summer; FSS), fertilized, and harvested a second time in November (forage sorghum-fall; FSF). All forage was ensiled in plastic bags and stored until the production trial began. Silages contained (dry matter basis) 8.0, 8.5, 9.0, and 9.5% crude protein; 39.0, 38.3, 54.2, and 55.1% neutral detergent fiber; and 3.6, 2.8. 7.7, and 7.8% acid detergent lignin, for CSS, CSF, FSS, and FSF, respectively. Forty-eight mid-lactation Holstein cows (153.5 ± 37.2 d in milk, 35.7 ± 6.2 kg/d of milk, 3.2 ± 0.6% fat, 611.8 ± 67.0 kg of body weight, and 2.96 ± 0.09 body condition score) were assigned randomly to 1 of the 4 diets differing in forage source. Cows were individually fed experimental diets once daily behind Calan doors for 5 wk. Diets were formulated to contain 38.7% of the experimental forages and balanced to provide equal concentrations of protein, fiber, and energy. No differences were observed in dry matter intake and yields of milk and components, but milk fat percentage was lower for CSS and CSF compared with FSS and FSF, being 3.20, 2.91, 3.42, and 3.53%, respectively. Milk lactose percentage was lower for CSS compared with CSF but was not different from FSS or FSF. Concentrations of milk urea nitrogen were lower for CSS and CSF compared with FSS and FSF (10.6, 13.4, 14.9, and 15.3 mg/dL, respectively). No differences were observed in body weight or body condition score change during the trial. Results of this trial suggest that silage produced from brachytic forage sorghum, as either the first or the ratoon crop, can support similar intake and performance as diets based on corn silage.
Key words: corn silage, forage sorghum, milk yield, milk composition

Short Communication

Forage sorghum (**FS**) is grown in many areas of the southern United States where irrigation is not available or limited because of its drought tolerance and lower water requirement compared with corn (Contreras-Govea et al., 2010). Compared with corn silage (**CS**), forage sorghum silage has lower starch and higher fiber concentrations, resulting in lower energy concentrations compared with corn (NRC, 2001). When lactating dairy cows were fed diets based on normal FS, milk yield was not different from that of cows fed tropical CS (Nichols et al., 1998) but was lower than of cows fed temperate CS (Aydin et al., 1999). Varieties of FS with the brown midrib 6 gene (**BMR**) produce forage that has lower lignin concentrations that support higher NDF digestibility (Contreras-Govea et al., 2010). Diets based on BMR FS have been reported to support FCM yields similar to that of cows fed diets based on CS (Grant et al., 1995; Aydin et al., 1999; Oliver et al., 2004).

Varieties with the brachytic dwarf gene are shorter (approximately 1.8 m in height versus ≥3.6 m) than normal FS and are more resistance to lodging. Yosef et al. (2009) reported similar forage DM yield and fiber digestibility for dwarf compared with a normal variety of FS. Brachytic dwarf varieties and the BMR gene are currently being used in forage production system by dairy producers, but data are limited as to the feeding value of these hybrids.

In the southern United States, a second crop of forage can be harvested without replanting when FS is planted in spring and allowed to ratoon. Yosef et al. (2009) reported higher NDF and lignin concentrations in the ratoon harvest of FS, but concentrations of other nutrients were similar. Those researchers did not observe any difference in nutrient digestibility when first or ratoon FS was fed to sheep (Yosef et al., 2009). Data are lacking on the production response of lactat-

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ing dairy cows or growing animals fed FS harvested from both the first and ratoon crops. The objective of this trial was to evaluate the effects of diets based on source of whole-plant silage (corn or forage sorghum) harvested in either summer or fall on intake and performance when fed to lactating dairy cows.

All forages were grown on the Animal and Dairy Science Department farm unit located on the University of Georgia Tifton Campus on a Tifton sandy loam soil. Temperate corn (Pioneer P1404, DuPont Pioneer, Johnston, IA) was planted on March 22, 2012, at a seeding rate of approximately 79,070 seeds/ha. Forage was harvested on July 24, 2012, and ensiled in a plastic bag until beginning of a production trial. The second crop (DeKalb 67–88, Monsanto Company, St. Louis, MO) was planted at the same seeding rate on July 31, 2012, and was managed as outlined for the first crop. Corn was harvested on November 8, 2012, and ensiled in a plastic bag.

A brachytic dwarf BMR FS variety (Alta 7401, Alta Seeds, Amarillo, TX) was planted at a seeding rate of approximately 276,000 seeds/ha (7.85 kg/ha) on April 12, 2012. Forage was harvested on July 25, 2012, when the grain had reached the soft dough stage of maturity, and ensiled in a plastic bag until the beginning of a production trial. The crop was fertilized and allowed to regrow and produce a second crop. The forage was harvested on November 9, 2012, at the soft dough stage of maturity and ensiled in a plastic bag.

For both CS and FS, 44.7 kg/ha N, 44.7 kg/ha P_2O_5, and 93.4 kg/ha K_2O were applied before planting and top dressed with 154 kg/ha N. The same fertilization program was used for the second crop of corn. The ratoon crop of forage sorghum received 73 kg/ha N, 18.3 kg/d P_2O_5, and 36.6 kg/ha K_2O and was top dressed with 154 kg/ha N. Herbicides were applied according to University of Georgia recommendations, and crops were irrigated as needed to maintain soil moisture.

Forty-eight lactating Holstein cows (16 primiparous and 32 multiparous, average 2.9 lactations) averaging 153.5 ± 37.2 DIM, 35.7 ± 6.2 kg/d of milk, 3.2 ± 0.6% fat, 611.8 ± 67.0 kg of BW, and 2.96 ± 0.09 BCS were used in a 7-wk randomized design trial. Cows were trained to eat behind Calan doors (American Calan, Northwood, NH) before beginning the trial. All cows were fed a basal diet based on CS harvested in summer for 2 wk and data collected for use as a covariate in the statistical analysis. At the end of the preliminary period, cows were assigned, within parity, to 1 of 4 treatments by ECM for the following 5 wk. Treatments include 4 forage sources: (1) summer CS (**CSS**), (2) fall CS (**CSF**), (3) summer FS (**FSS**), or (4) regrowth fall FS (**FSF**). Diets (Table 1) were formulated to provide equal concentrations of protein, NDF, and energy based on preliminary forage analysis and fed as a TMR once daily in amounts to provide a minimum of 5% orts.

The amount of feed offered and refused was recorded daily. Samples of dietary ingredients, experimental rations, and orts were collected for DM analysis 3 times each week. Rations were adjusted as necessary to account for changes in the DM content of individual ingredients. Individual samples were composited by week and ground to pass through a 1-mm screen using a Wiley mill (Thomas Scientific, Swedesboro, NJ). Forage samples were analyzed for concentrations of DM, ash (AOAC International, 2000), CP (Leco FP-528 Nitrogen Analyzer, St. Joseph, MO), ADF (AOAC International, 2000), NDF adjusted for ash (Van Soest et al., 1991), ADL adjusted for ash, 30-h NDF digestibility (Goering and Van Soest, 1970), sugar (Dubois

Table 1. Ingredient composition of experimental diets (% of DM)

Ingredient	Corn silage	Forage sorghum
Corn silage[1]	38.71	
Forage sorghum[2]		38.71
Oat baleage	6.88	3.44
Brewers grains, wet	11.61	11.61
Whole cottonseed	5.59	
Ground corn	19.96	26.41
Soybean hulls	2.06	2.06
Soybean meal	3.48	6.06
Megalac[3]	1.72	1.72
Amino Plus[4]	2.84	2.84
Prolak[5]	3.18	3.18
Urea	0.26	0.26
Salt	0.26	0.26
Calcium carbonate	0.86	0.86
Potassium carbonate	0.60	0.60
Magnesium oxide	0.26	0.26
Sodium bicarbonate	0.77	0.77
Availa-4[6]	0.03	0.03
Potassium magnesium sulfate	0.17	0.17
Omigen-AF[7]	0.22	0.22
Monensin,[8] 3 g/454 g	0.38	0.38
Vitamin E, 20,000 IU/454 g	0.02	0.02
Trace-mineral-vitamin premix[9]	0.14	0.14

[1]Corn silage was provided from silage harvested during the summer or fall.

[2]Forage sorghum was provided from silage harvested during the summer or fall.

[3]Calcium salts of long-chain fatty acids (Arm Hammer Animal Nutrition, Church & Dwight Co. Inc., Princeton, NY).

[4]Ruminally protected soybean meal (Ag Processing Inc., Omaha, NE).

[5]Marine and animal rumen undegradable protein supplement (H. J. Baker & Bros. Inc., Westport, CT).

[6]Organic zinc, manganese, copper, and cobalt (Zinpro Corp., Eden Prairie, MN).

[7]Immune stimulant (Prince Agri Products Inc., Quincy, IL).

[8]Rumensin (Elanco Animal Health, Indianapolis, IN).

[9]Mineral-vitamin premix contained (DM basis): 26.1% Ca; 0.38% Mg; 1.76% S; 144 mg/kg of Co; 9,523 mg/kg of Cu; 1,465 mg/kg of Fe; 842 mg/kg of I; 28,617 mg/kg of Mn; 220 mg/kg of Se; 25,343 mg/kg of Zn; 4,210,830 IU/kg of vitamin A; 1,684,330 IU/kg of vitamin D; 21,045 IU/kg of vitamin E.