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Eastern Gamagrass: Determining its role in the feeding of lactating cows

Abstract

Three production trials were conducted to determine the role of Eastern gamagrass in the feeding of lactating cows[1]. The trial was conducted with 16 lactating Holstein cows (165.2 ± 8.7 DIM) milked three times daily at Cornell University and with 10 lactating Holstein cows milked twice daily at SUNY-Cobleskill. The Cornell University (CU) trial was a continuous trial with production parameters of the previous week used as a covariate. The SUNY-Cobleskill trial was a switchback design with 28 d periods. Dry matter intake was lower for cows consuming gamagrass in the CU trial, but milk production did not differ between the diets. In the SUNY-Cobleskill trial, there were no differences in dry matter intake, milk production, or milk composition. Results from this study indicate that gamagrass can be used to replace the fiber coming from corn silage. This will result in considerably more grain being brought from off farm. Whether or not this is economically feasible will depend on the price of grain. Nutrient management aspects of possibly increasing feeds brought from off farm need to be considered.

Introduction

Eastern gamagrass is a long-lived, warm season perennial grass. It is very productive and digestible and may be useful in lieu of corn silage on sloping and marginal cropland (Dickerson and van der Grinton, 1990). Eastern gamagrass has produced yields up to 9000lb/ac DM on a Unadilla silt loam with only two cuttings in NY (Salon and Cherney, 1994). In the Northeast cropland erosion is largely derived from silage corn production and contributes to many water quality problems. Many silage

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[1] Only data from two of the trials are considered in this report. Data from the third trial is not yet analyzed.

cornfields are not producing at or above the 15-tons/ac break-even level (Dickerson and van der Grinten, 1990). Eastern gamagrass may be an alternative on some of these soils.

The forage of eastern gamagrass is highly digestible if harvested at the proper stage of maturity. Horner et al. (1985) reported that although neutral detergent fiber (NDF) and acid detergent fiber (ADF) were lower in alfalfa, dry matter (DM) and fiber digestibility of eastern gamagrass was higher. Apparent digestibility of Eastern gamagrass grown in NY is reportedly higher than those reported in Oklahoma (Salon et al., 1994). For dairy farmers to switch some of their corn land into gamagrass, it must be demonstrated that gamagrass can fit economically into a production system. Salon and Cherney (1999) have reported on management practices to optimize agronomic yield and quality of gamagrass in NY, but information is lacking on its production potential in the high producing, lactating cow.

Materials and Methods

Three feeding trials using lactating Holstein cows were conducted. Trials were conducted at Cornell University, SUNY Cobleskill and SUNY Morrisville. The design at each location was originally intended to be a switch-back using 10 cows per treatment, each period will consisting of 28 days. In the Cornell University trial, however, silage was limited and the trial was altered to be a continuous trial with eight Holstein cows (165.2 ± 8.7 DIM) per treatment. All cows were fed the regular herd ration for a week prior to the onset of the trial to be used as a covariate. In all trials cows were randomly assigned to treatments.

Milk production and quality were monitored throughout the studies (One sample at each milking once a week). SUNY Morrisville and SUNY Cobleskill milked two times daily, Cornell University milked three times daily. Milk samples were analyzed for fat, protein, lactose, and milk urea nitrogen (MUN), by Dairy One (DHI Forage Testing Laboratory, Ithaca, NY).

Cows for all three studies were housed in individual tie stalls throughout the experiment and had free access to water throughout the trial. Cows were offered a total mixed ration (TMR) for ad libitum intake once daily to allow for 10% refusal. Dry matter intake was monitored daily throughout the study. A sample of feed offered and feed refused was collected daily during the final week of each period for the SUNY Cobleskill and SUNY Morrisville trials. Samples were collected during the final two days of each period for the Cornell University trial. Samples were analyzed for fiber and protein composition by Dairy One.

Diets were balanced for total protein, energy, and minerals. Diets were formulated with Spartan Ration Evaluator/Balancer for Dairy Cattle (1992) for a theoretical 1300 kg Holstein cow 60 DIM, producing 85lbs of milk/d (milk fat – 3.8%; milk protein 3.2%) to meet NRC requirements for dairy cattle (NRC, 1989). Dry matter intake was targeted to be 48lbs/d. Diets were in the range of what is considered a normal diet for a cow in late lactation in the US. Treatments consisted of a corn-silage based total-mixed ration and a total-mixed ration in which gamagrass replaced the corn silage. Diets varied somewhat at each location to match herd rations used by the farm herds (Tables 1 through 4[2]).

Eastern gamagrass was grown and ensiled at each farm location. Gamagrass was ensiled in AgBags. SUNY Cobleskill gamagrass was somewhat lower in quality than that

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[2] Only Cornell University and SUNY Cobleskill data are reported at the time of this report. Although the trial at SUNY Morrisville is complete, data have not yet been analyzed.

at Cornell University, but was still within that reported for quality of Gamagrass reported in New York (Salon et al., 1999).

Data for the three trials was analyzed using the general linear model procedure of SAS (1989). Differences among means were evaluated using F tests. Significance was $P < 0.05$ unless otherwise stated.

Results

Diets varied somewhat at each location to match herd rations used by the farm herds (Tables 1 and 3).

Cornell University Trial

In the Cornell University trial, Eastern gamagrass was used to replace only the fiber from corn silage in the diet. This change resulted in an increase of high moisture corn from 24.3% in the corn silage diet to 42.9% in the gamagrass diet (Table 1). Changes in the diet also included the addition of .25 lbs per cow of Megalac, a fat supplement, needed to overcome an energy deficit in the gamagrass diet. Diets were formulated to be similar in fiber, energy, and protein (Table 2). The Eastern gamagrass tended to be dryer than the corn silage and was used at lower quantities than corn silage, resulting in a TMR that was dryer than the corn-silage TMR. Forage to concentrate ratio was lower in the corn-silage TMR because of its higher energy value and lower NDF value (Table 2).

Cows on the Eastern gamagrass diet had lower dry matter intake than those on the corn silage diet (Table 5). There were no differences in milk production, however. Higher milk fat in milk from cows consuming the Eastern gamagrass silage may have been due to the 0.25 lbs of Megalac in that diet. Lower protein and lactose may have been due to the slightly higher (though not significantly higher) milk production from cows on the Eastern gamagrass diets. Milk urea nitrogen was slightly higher in milk from cows fed the corn-silage diet. This diet had a slightly higher CP than the Eastern gamagrass diet, possibly resulting in the small difference observed.

SUNY-Cobleskill Trial

In the Cobleskill trial, Eastern gamagrass replaced all the fiber from corn silage and the mixed grass hay (Table 3). Like the Cornell University trial, using Eastern gamagrass resulted in diets than contained considerably more concentrate than the corn-silage diet, and was drier than the corn-silage diet (Table 4).

There were no differences in crude protein between the two TMR's, although the acid detergent insoluble crude protein (ADICP) was slightly higher in the corn-silage diet (Table 4). This difference in ADICP, an indication of unavailable protein, is small and in both cases less than one. It is unlikely that this difference would result in differences in protein allowable milk to the cow (Van Soest et al., 1994). Acid detergent fiber and NDF were slightly higher in the corn silage diet, resulting in slightly lower total digestible nutrients (TDN) and net energy for lactation (NEL; Table 4). These small differences between diets did not result in differences in milk production or milk composition from cows consuming these diets (Table 6). All cows produced less milk in the second period (Figure 1). There were no diet x period interactions.

Discussion

Horner et al. (1985) observed that lactating cattle consumed more alfalfa hay (21.7 lbs) than gamagrass silage (19.8 lbs), resulting in higher milk production for those cows consuming alfalfa hay (53 lbs vs. 50 lbs). High producing milk cows in the

Northeast typically are fed concentrates with the forage, so DM intakes and milk production are typically much higher than was observed by Horner et al. (1985), even by cows in late lactation. In both the Cornell University and SUNY-Cobleskill trials, cows consumed in excess of 50 lbs DM intake (Tables 5 and 6). Mertens (1994) suggested that cows would be limited by fill when they consumed diets greater than 1.2% of BW as NDF. Cows consuming diets in these trials were unlikely to have been limited by fill.

In both trials, milk production was much higher than that observed by Horner et al. (1985). This is do to the approximately 50% or more concentrate in the diet. If Eastern gamagrass is to find a niche in the Northeast, it must fit into conventional TMR's. Gamagrass must be able to be used as the fiber source. The two trials described here demonstrate that gamagrass can be used as the fiber source in the diets of high producing cows in later lactation, without compromising intake or milk production. Forage to concentrate ratios were decreased considerably, however, by the substitution of the gamagrass for the corn silage. The levels included here approached the minimum forage content that would be necessary to maintain rumen function (Mertens, 1994). Particle size and effective NDF would become important considerations when feeding concentrates at this level (Cherney, 2000). The Cornell University gamagrass was somewhat lower in fiber than the SUNY-Cobleskill gamagrass. This resulted in higher forage to concentrate ratios for the Cornell University trial. Optimizing the quality of the gamagrass would be critical at these levels of concentrate inclusion. Cherney and Cherney (1999) and Jonker et al. (2001) demonstrated the importance of forage quality when feeding grass diets to dairy cattle on the influence of forage to concentrate ratios and where nutrient management is concerned.

Conclusion

Eastern gamagrass can be used to replace corn silage in TMR's of cattle producing moderate to high levels of milk. The lower energy value of the Eastern gamagrass, however, requires the inclusion of much more grain in the diet, resulting in low forage:concentrate ratios. There are several areas of concern when these high levels of grain are used. Cost of the ration may be increased, although this will be highly dependent on the cost of the grain. Nutrient management needs to be considered. The use of homegrown feeds to reduce imported feeds onto the farm can have a favorable impact on farm nutrient balance (Tylutki and Fox, 1997). If these Eastern gamagrass diets result in more grain being purchased off farm, then there will be a negative impact on nutrient balance. High levels of grain can lead to metabolic disorders in cattle. If used, forage quality will be critical, as has been observed with other perennial forages.

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Table 1. Diet composition - Cornell University trial.

		Diet		
Component[1]	% of Diet, DM basis	CP %	ADF %	NDF %
Corn silage				
Hay crop Silage- 1	4.7	23.4	31.4	42.8
Hay crop Silage-2	9.1	19.4	37.2	51.0
Corn Silage	31.1	8.2	24.5	39.2
Kansas Alfalfa Hay	9.3	23.4	29.0	36.5
High moisture corn	24.3	8.8	3.1	9.0
Soybean Meal	4.6	52.4	9.0	9.5
Homermeal	6.6	48.1	8.5	26.4
Cottonseed	7.4	24.7	35.5	45.7
Limestone	0.9	0	0	0
Sodium Bicarb	0.8	0	0	0
Mineral Mix	1.3	0	0	0
Eastern gamagrass silage				
Hay crop Silage- 1	11.1	23.4	31.4	42.8
Hay crop Silage-2	5.5	19.4	37.2	51.0
Gamagrass Agbag	19.4	14.6	38.2	66.3
High Moisture Corn	42.9	8.8	3.1	9.0
Soybean Meal	0.2	52.4	9.0	9.5
Homermeal	9.4	48.1	8.5	26.4
Cottonseed	7.8	24.7	35.5	45.7
Limestone	1.0	0	0	0
Sodium Bicarb	0.8	0	0	0
Mineral Mix	1.4	0	0	0
MEGALAC low oder	0.5	0	0	0

[1]Reported as % of DM; CP=crude protein, ADF=acid detergent fiber, NDF=neutral detergent fiber.

Table 2. Chemical composition of diets used in Cornell University trial.

Component[1]	Diet: Corn silage	Diet: Eastern gamagrass silage
Forage to concentrate ratio	54:46	36:64
Dry Matter	48.1	52.4
Crude protein	17.2	16.8
Acid detergent fiber	19.5	17.9
Neutral detergent fiber	29.7	30.4
NEL[1]	0.77	0.77

[1]NEL=net energy for lactation.

Table 3. Diet composition – SUNY Cobleskill trial.

Component[1]	% of Diet, DM basis	Diet: CP, %	Diet: ADF	Diet: NDF
<u>Corn silage</u>				
Mixed Legume Silage	21.1	17.8	39.3	48.8
Corn Silage	25.5	8.9	24.1	44.2
Mixed Grass Hay	4.1	7.1	47.0	71.6
Protein Mash	17.9	44.3	6.5	11.0
Corn-Citrus Pulp	30.6	9.1	8.6	13.1
Soybean Meal	0.6	55.0	6.0	10.0
<u>Eastern gamagrass silage</u>				
Mixed Legume Silage	2.9	17.8	39.3	48.8
Gamagrass Silage	27.3	8.9	24.1	44.2
Protein Mash	17.9	44.3	6.5	11.0
Corn-Citrus Pulp	51.2	9.1	8.6	13.1
Soybean Meal	0.6	55.0	6.0	10.0

[1]Reported as % of DM; CP=crude protein, ADF=acid detergent fiber, NDF=neutral detergent fiber.

Table 4. Chemical composition of diets used in SUNY-Cobleskill trial.

	Diet	
Component[1]	Corn silage	Eastern gamagrass silage
Forage to concentrate ratio	51:49	30:70
Dry Matter	46.2a[1]	56.3[b]
Crude protein	16.5[a]	16.2[a]
ADICP[2]	.95[a]	.81[b]
Acid detergent fiber	22.3[a]	19.8[b]
Neutral detergent fiber	33.0[a]	30.2[b]
TDN	69.6[a]	70.7[b]
NEL	.74[a]	.75[b]

[1]Means within a row with different superscript are different ($P < 0.1$).
[2]ADICP=acid detergent insoluble crude protein; NEL=net energy for lactation.

Table 5. Production parameters as influenced by forage source Cornell University Trial.

	Treatment	
Component	Corn silage	Eastern gamagrass silage
Dry matter intake, lbs d^{-1}	56.6[a1]	54.9[b]
Milk production, lbs d^{-1}	91.3[a]	94.7[a]
Milk fat, %	3.4[a]	3.5[b]
Milk protein, %	2.97[a]	2.78[a]
Milk lactose, %	4.80[a]	4.68[b]
Milk urea nitrogen, mg/dl	13.1[a]	11.3[b]

[1]Means within a row with different superscript are different ($P < 0.1$).

Table 6. Production parameters as influenced by forage source SUNY-Cobleskill Trial.

Component	Treatment	
	Corn silage	Eastern gamagrass silage
Dry matter intake, lbs d^{-1}	53.7[a1]	54.2[a]
Milk production, lbs d^{-1}	70.3[a]	64.9[a]
Milk fat, %	4.26[a]	4.07[a]
Milk protein, %	3.17[a]	3.59[a]
Milk lactose, %	4.82[a]	5.17[a]
Milk urea nitrogen, mg/dl	12.2[a]	15.4[a]

[1]Means within a row with different superscript are different ($P < 0.1$).

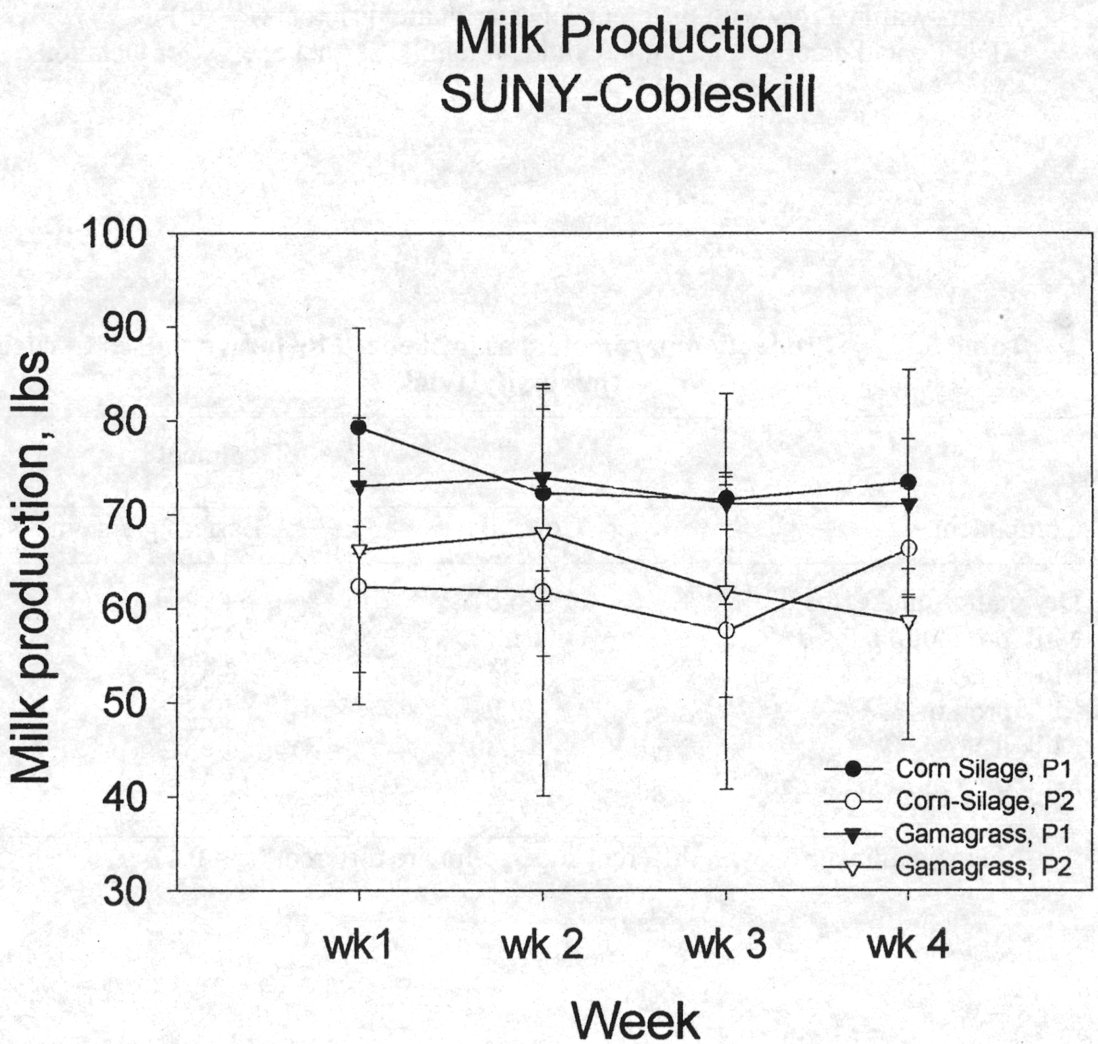

Figure 1. Milk production of cows fed a corn-silage TMR or Eastern gamagrass silage TMR. Bars indicate STD.