COMPARATIVE VALUE OF GRASS SILAGE TO CORN SILAGE AS FORAGES FOR COW AND HEIFER DIETS

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Bermudagrass.

Bermudagrass has excellent agronomic characteristics making it a popular, perennial forage grown in much of the Southeast, including Florida. It has high yielding ability, high drought tolerance, and tolerance to acid soils. High forage yields can be obtained if the grass is fertilized properly. Table 1 shows the effect of fertilizer rate on the yield and protein content of 16% moisture Coastal bermudagrass hay cut every 4 weeks during a year of excellent rainfall (39.7 inches from April 1 to November 1) and one of extremely dry conditions (13.7 inches). As more fertilizer was applied to the grass, more tons of hay were harvested and the higher the protein % of the hay harvested. The biggest jump in yield and % protein occurred when fertilization went from 100 pounds of N and 250 pounds of 0-10-20 up to 300 pounds of N and 750 pounds of 0-10-20. Yield increased 80% (from 4.4 to 7.9 tons) in 1953 and 110% (from 2.0 to 4.2 tons) in 1954. Percent protein increased about 4 percentage units during each of the two years going from an average of 11.1% to 15.3%. During both years, additional significant jumps in yield (36% increase) and protein (14.7% average increase) occurred when 600 pounds of N and 1500 pounds of 0-10-20 were applied per acre but little response was seen in the dry year when fertilizer rate was increased again. When a growing season receives 26 inches of rain, production should be similar to that observed during the wet year. Current recommendations for fertilization when the grass is to be used for hay or silage, are 80 pounds per acre of N, all of the P_2O_5 and K_2O early in the spring. Then apply an additional 80 pounds of N and 40 pounds of K_2O per acre after each cutting. Table shows how drought tolerant Coastal was in that 4 to 5 tons were still produced during the record drought season.

Table 1. The Effect of Annual Fertilizer Rate on the Yield and Protein Content of Coastal Bermudagrass Cut Every 4 Weeks in 1953 With Excellent Rainfall and 1954, the Driest Season on Record.

lbs. of fertilizer applied per acre		Tons of hay produced/A per year		Crude protein in the dry hay		Pounds of protein produced/A per year		
N	0-10-20	1953	1954	1953	1954	1953	%	1954
0	0	1.2	.5	9.2	10.9	188		88
100	250	4.4	2.0	11.2	11.0	827		374
300	750	7.9	4.2	15.2	15.4	2016		1111
600	1500	9.7	5.0	17.0	18.1	2761		1514
900	2250	10.5	5.1	19.6	18.7	3464		1612

Rainfall from April 1 to November 1 was 39.66 inches in 1953 and 13.68 inches in 1954.

Several hybrids of bermudagrass are available. The relative performance of six hybrids as summarized by Glenn Burton at Tifton, Georgia are in Table 2.

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All except Coastcross-1 could be grown in northern Florida although Callie is borderline. Quality is fairly comparable among the varieties except that of Alicia bermudagrass which is poor. Coastal is also lower than the other newer hybrids. The digestibility of several bermudagrass cultivars grown in Gainesville were compared (1988 Florida Field and Forage Crop Variety Report). Coastal averaged 57.3% while Tifton 44 was 61.0%, Tifton 78 was 62.3%, and Callie was 62.5%. Why plant Coastal at this time when other hybrids of higher quality are available?

Table 2. Relative Performance of Six Bermudagrasses Based on Research From Across the South.

Grass	Winter survival	Forage yield*	Short day yield	Seed yield	Rhi-zomes	Rel ADG's with cattle grazed	hay	Quality IVDMD	Pro-tein	Rust
Coastal	3	1.0	3	Trace	Some	100	100	6	3	0
Alicia	4	1.0	3	Little	Many	80**		9	3	5
Coastcross-1	9	1.0	1	None	None	140	130	1	1	0
Callie	9	1.0	1	Some	Few	118		2	2	9
Tifton 44	1	1.0	3	Little	Many+	119	120	4	3	0
Tifton 78	3?	1.0+	1	None	Many	136	135	2	2	0

Ratings: 1 = best, 9 = poorest, 0 = no rust. *Following mild winters, **Estimated from IVDMD data.

Corn Silage.

Corn silage is a high energy, readily digestible forage that is very palatable to cows and heifers. It yields more digestible energy per acre than any other feed crop when the land and the climate are suitable for corn. For this reason and because energy is most often the first limiting component in the diet for lactating dairy cows, corn silage may arguably be the most popular forage fed on today's dairies nationwide. Although the number of acres of corn for silage traditionally have not been that many across our state, corn silage is rapidly becoming a more common ingredient in the diets of Florida dairy cows. The number of acres on dairies dedicated to corn are increasing while other dairymen are purchasing the silage rather than growing it themselves.

Production Costs of Bermudagrass and Corn Silages.

Cost per ton to grow, harvest, pack, and store bermudagrass silage and irrigated corn silage according to the cost figures of Tim Hewitt at Marianna, Florida are in Table 3. It costs a little over $10 more per ton to produce corn silage ($26.10) than bermudagrass ($15.82) with the biggest difference being growing costs. It costs over twice as much to grow corn as bermudagrass. Although fertilizer costs are greater for bermudagrass, herbicide, insecticide, and machinery costs are greater for producing corn silage. Establishment costs for bermudagrass were prorated over a ten year period.

Table 3. Cost to Grow, Harvest, Haul, Pack, and Store Corn Silage and Bermudagrass Silage.[1]

	Corn Silage[2] $/ton as-is	Bermudagrass[3] $/ton as-is
Growing	15.46	6.99
Harvest, haul, pack[4]	4.46	3.99
Storage	2.78	2.78
Subtotal	22.70	13.76
Loss[5]	3.40	2.06
Total	26.10	15.82

[1]Tim Hewitt, U of FL, Marianna, FL.
[2]Irrigated; yield of 22 tons/acre (30% DM).
[3]Yield of 30 tons/acre (30% DM).
[4]10′ x 45′ x 245′ concrete bunker, 20 year life expectancy.
[5]Fifteen percent loss of silage during storage is expected.

Nutrient Concentration.

The chemical composition of corn silage and bermudagrass is in Table 4. A limitation of corn is that it is relatively low in protein, calcium, phosphorus, and sodium in comparison to other feed ingredients. Bermudagrass is also low in these nutrients as well as magnesium. In addition, bermudagrass is quite high in total fiber (neutral detergent fiber), about 50% higher than corn silage, and quite low in energy, about 27% lower than corn silage. So corn silage holds a distinct edge in energy while bermudagrass can hold a distinct edge in protein if it is fertilized properly.

Table 4. Average Nutrient Content of Late Dent Corn Silage and Five to Six-week Old Regrowth Coastal Bermudagrass.

Nutrient	Corn Silage	Bermudagrass
Dry matter, %	32	28
Crude protein, % DM	8.2	15.0
Net energy lactation, Mcal/lb DM	.68	.56
TDN, %	66	55
Neutral detergent fiber, % DM	51	75
Acid detergent fiber, % DM	31	35
Calcium, % DM	.27	.32
Phosphorus, % DM	.20	.20
Potassium, % DM	1.05	1.70
Magnesium, % DM	.25	.16
Sulfur, % DM	.13	.20
Sodium, % DM	.01	.03
Iron, ppm	290	161
Manganese, ppm	34	127
Zinc, ppm	44	29
Copper, ppm	7	11

Lactation Studies.

Bermudagrass has been compared to corn silage as a dietary ingredient for lactating cows in only a few studies. Most of these experiments were done with Coastal bermudagrass. Several of the varieties on the market today would definitely outperform Coastal. One experiment was done at Tifton, GA where corn silage and Coastal bermudagrass silage were fed as the only roughage in two trials (Table 5). In Trial 1, cows ate the same amount of dry matter regardless of forage but cows fed corn silage gave 1.5 pounds per day more milk than cows fed Coastal bermudagrass. In their second trial, cows ate 3.1 more pounds of corn silage than Coastal bermudagrass and produced 3.8 pounds more milk.

Table 5. Performance of Dairy Cows Fed Corn Silage or Coastal Bermudagrass Silage as Their Only Forage.[1]

	Corn Silage	Coastal Bermudagrass Silage
	pounds/day	
Trial 1		
Dry matter intake[2]	20.8	20.5
Milk yield	27.2	25.7
Body weight gain	0.1	1.9
Trial 2		
Dry matter intake	24.6	21.5
Milk yield	30.7	26.9
Body weight gain	.73	-.61

[1]Univ. of Georgia, Tifton, J. Dairy Sci. 44:974.
[2]Based upon 1200 pound cows.

In another experiment, corn silage or Coastal bermudagrass hay was mixed in four forage to concentrate ratios (Mertens, 1982). The concentrate was mainly ground corn and soybean meal. The bermudagrass hay was mixed with concentrate at approximately the following dry matter ratios: 27:73, 40:60, 53:47, and 66:34. Corn silage was mixed with concentrate at different dry matter ratios. They were 42:28, 56:44, 75:25, and 89:11. Milk yield for cows was a curve when plotted over the different forage to concentrate ratios (Figure 1). Dry matter intakes followed a similar curve. When the forage to concentrate ratio was similar between the two forages (approximately 41:59), cows produced about 2.2 pounds more milk when fed corn silage. The higher energy found in the corn silage would account for this difference. This ratio provided the peak milk yield for cows fed bermudagrass. However, this ratio was not peak milk for cows on the corn silage diet. Even more milk could be obtained by cows fed corn silage, not by feeding more grain but by feeding less grain. This would result in a bigger milk check with a smaller feed bill.

Mississippi workers (Tomlinson, personal communication) compared Tifton 44 bermudagrass to Tift Leaf pearl millet and corn silage in 1987. The bermudagrass and pearl millet were rotationally grazed while corn silage was fed to a third group under shelter. Cows were supplemented with concentrates at the

rate of 1 pound of grain to 3 pounds of milk twice a day. Yield of 4% fat-corrected milk was not different among the cows, being 47.6, 50.3, and 49.8 pounds for each treatment. Pearl millet plants were planted too close together and a lot of trampling occurred. In 1988, only Tifton 44 bermudagrass was compared to Tift Leaf pearl millet under rotational grazing management (Murphy et al. 1989). Two major differences occurred in 1988 vs. 1987 which influenced the results. The year was much drier than 1987 and secondly, the pearl millet was planted in 16 inch rows so that animal trampling was greatly reduced.

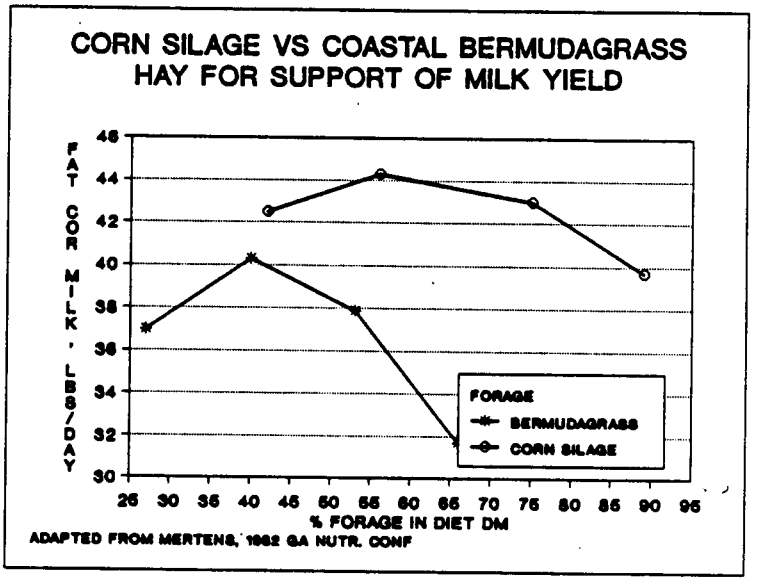

Figure 1

Grain was fed at the same 1 to 3 ratio as in 1987. Cows grazing pearl millet outperformed those grazing bermudagrass by a wide margin. Cows on millet produced 54.6 pounds of milk at 3.06% fat while cows on bermudagrass produced 41.8 pounds of milk at 3.29% fat. Four % fat-corrected milk favored cows on millet 46.5 to 37.4 pounds for cows on bermudagrass. Income over feed costs were $1.24 better for millet than bermudagrass ($3.82 vs. $2.57). It appears that the occurrence of a dry year without irrigation can seriously reduce the nutritive value of bermudagrass.

Ration Formulation.

Rations were formulated containing each of the two forages to support 80 pounds of milk by 1300 pound cows. Corn silage was of average quality while the bermudagrass silage was of very good quality. Composition of the diets were 49.3% water, .78 Mcal/pound, 17% protein, 20.6% acid detergent fiber, .65% calcium, .42% phosphorus, 1.17% potassium, and .25% magnesium dry matter basis. The silages were included in the diets at the maximum amounts possible without creating diets that were over 50% water. This allowed us to feed 60 pounds per day of corn silage at 70% water and 55 pounds per day of bermudagrass silage at 72% water (Table 6). No wet brewers grain was included in these rations. Rations containing wet brew would force us to reduce the amount of silage fed in order to keep the water content of the ration down to around 50%. Maximizing the amount of forage fed provides the cheapest diet as long as the nutrient requirements of the cows can be met. This amount of silage can be fed in the winter but should be reduced about 40 to 50% in the summer. Cows fed the bermudagrass silage diet would likely eat less feed than those fed corn silage because of greater fiber fill. A difference of 5.5 pounds of as-is feed intake is listed in Table 6.

Table 6. Sample Rations Containing Corn Silage or Bermudagrass Silage to Support 80 Pounds of Milk by Cows Weighing 1300 Pounds.

Ingredient	Corn Silage	Bermudagrass silage
Corn silage	60.0	----
Bermudagrass silage	----	55.1
Bermudagrass hay	4.0	----
Ground corn	12.3	17.1
Soybean meal	6.1	2.5
Distillers grain	2.9	3.0
Whole cottonseed	5.1	7.1
Limestone	.353	.419
Dicalcium phosphate	.287	.287
Trace mineral salt	.198	.198
Buffer	.463	.463
Magnesium oxide	----	.022
Total	91.7	86.2

What about the economics? Income over feed costs can be calculated using today's prices. Costs per ton for the major feed ingredients used were $119 for corn, $228 for soybean meal, $165 for distiller grains, and $185 for whole cottonseed. Silage costs were as in Table 3. The cost of the bermudagrass ration was $.39 per cow per day cheaper than the corn silage ration ($3.14 vs. $2.75). What about milk income? Based upon the data in Table 5 and Figure 3, cows fed the corn silage diet would likely produce about 3 pounds more milk than those fed the bermudagrass silage diet. With milk income at $0.145 per pound, a $0.43 advantage (3 pounds x $0.145/pound) goes to the corn silage group. In summary, the net effect is $0.04 per cow per day advantage for the corn silage diet ($0.43 milk advantage minus $0.39 feed disadvantage).

Watch Forage Quality.

It must be emphasized that the bermudagrass silage used in this example was of very good quality, having a protein content of 15% and an energy value of .56 Mcal per pound. Feeding a lower quality bermudagrass unfortunately is easy to do. Feeding grass harvested later in the growing season or grass harvested beyond 4 to 5 weeks in regrowth or grass improperly fertilized can cut milk production drastically. If this happens or if higher quality corn silage is harvested and fed than in our example, this economic advantage to corn silage diets will widen.

Let me illustrate how changing bermudagrass quality can impact milk production using some data collected at Louisiana State University. Coastal bermudagrass was harvested as hay every 4, 6, or 8 weeks throughout the growing season. The grass received 100 pounds of nitrogen after every cutting. Grass harvested every 4 weeks ranged in protein content from 14 to 16% throughout the growing season (Figure 2). However when 6 or 8 weeks elapsed between harvests, protein content decreased to between 10 and 13%. Usually 8 week regrowth bermudagrass had even less protein than 6 week old forage. Protein concentration

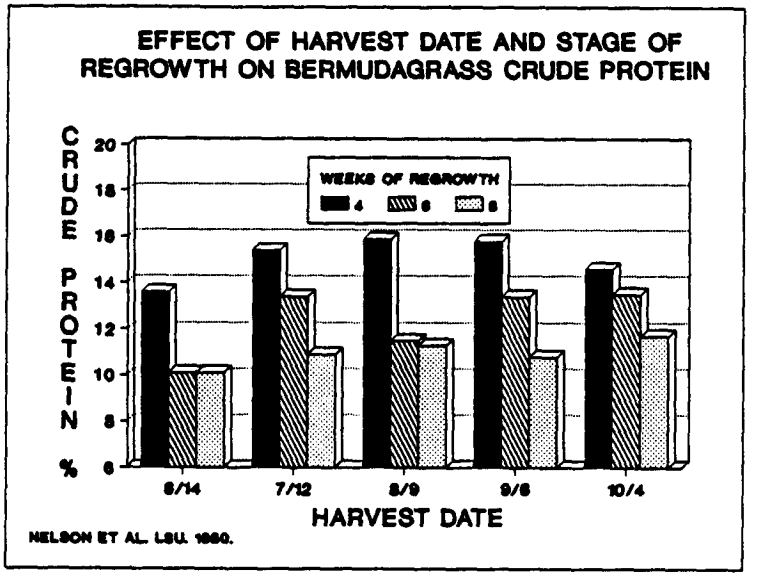

Figure 2

forages' protein content is not a good indicator of its' quality as will be discussed next.

When the hay was fed to steers to measure digestibility, grass harvested at 4 weeks was of highest quality, being more digestible than 6 or 8 week regrowth in all but the last cutting in October (Figure 3). But unlike protein, as the growing season progressed from June to October, digestibility of every cutting interval decreased. Dry matter digestibility of 4 week regrowth grass harvested in October was 9% lower than that harvested in June and 12% lower than that harvested in July. If bermudagrass harvested in October replaced July-harvested grass with no other change in the ration, milk production would fall at least 7 pounds per day.

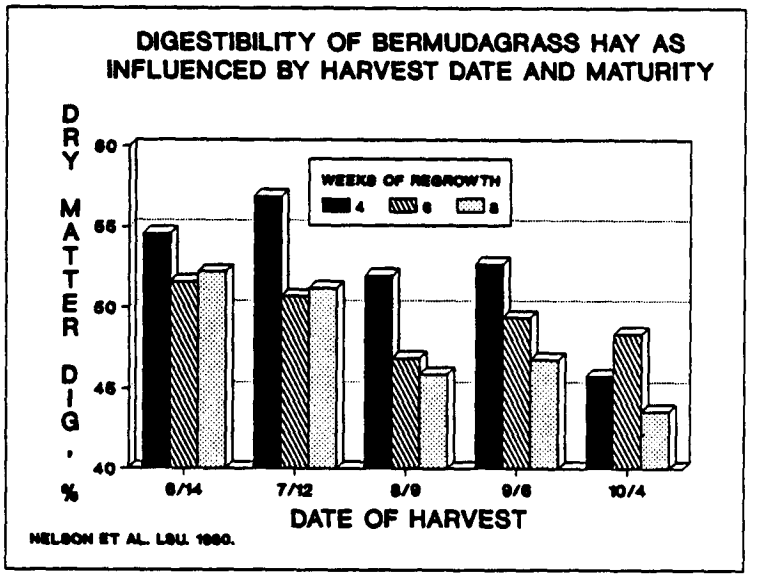

Figure 3

Heifers.

How does bermudagrass stack up against corn silage as feedstuffs for growing heifers? Much better than in diets for lactating cows. Three diets were formulated using the crude protein and energy values for the three maturities of bermudagrass shown in Figures 2 and 3. Five hundred pound Holstein heifers weighing an average of 500 pounds were set to gain 1.7 pounds per day (Table 7).

A concentrate mixture made up primarily of corn and soybean meal was used to help balance the diets. An equal mixture (50:50) of concentrate and hay of the youngest forage maturity would supply all the nutrient requirements. No soybean meal was needed in this diet as the 15% protein grass was able to supply all the protein requirement. If one was feeding the grass of medium maturity and quality, the proper hay to grain ration changes to 40:60. Even more grain is needed when the most mature hay is used so that the proper forage to grain ratio should be 30:70. An additional pound of grain per head per day is needed when the hay fed increases two weeks in maturity. Total cost of each ration also increases with the biggest jump occurring beyond 28 days regrowth. A corn silage and soybean meal diet in an 88:12 ration makes up the fourth balanced diet. The cost of this diet was from $.03 to $.22 per head per day more expensive than the bermudagrass:grain diets. The cheaper price of the perennial grass can really have an impact in these heifer diets because the grass can be fed in higher quantities than in the lactating cow diets. For 900 pound heifers, bermudagrass can have even a larger role in the diet than with the small heifers.

Table 7. Bermudagrass Hay to Corn-Soybean Meal Ratio Required to Feed 500 Pound Holstein Heifers Gaining 1.7 Pounds Per Day.

Bermudagrass Maturity	Bermudagrass to Corn Ratio	Total Intake	Diet Cost
(days)	(dry matter basis)	(lb,DM)	($/d)
15-28	50:50	12.1	.49
29-42	40:60	11.7	.63
43-56	30:70	11.3	.68
Corn silage = SBM	88:12	11.9	.71

In conclusion, corn silage based diets appear to be more profitable than Coastal bermudagrass based diets for lactating cows while the reverse is true for growing heifers. Up to this point, Coastal bermudagrass has been the only cultivar of bermudagrass evaluated against corn silage and that of a high quality. Improved bermudagrass cultivars such as Callie, Tifton 44, or Tifton 78 may prove to be more competitive with corn silage than Coastal in lactating cow diets. Whether it is enough to make the grass diets more economical than the corn silage diets is unknown. If these new cultivars have improved rates of digestion as well as improved extents of digestion, then the chances for closing this gap significantly is good.

REFERENCES CITED

1. Burton, Glenn W. 1986. Bermudagrass varieties for top quality and yield. In Proc. Florida Dairy Production Conference, page 55.

2. Florida Field and Forage Crop Variety Report. 1988. Agronomy Research report AY 88-02, p. 52.

3. Hewitt, Tim. 1989. Production and harvesting costs for forages for silage. Extension handout. Univ. FL. Agric. Res. and Ed. Center, Marianna, FL.

4. Johnson, J.C., F.E. Knox, and B.L. Southwell. 1961. Relative feeding value of Coastal bermudagrass silage and corn silage for lactating dairy cows. J. Dairy Sci. 44:974 (Abstr.).

5. Mertens, D. R. 1982. Using neutral detergent fiber to formulate dairy rations. In Proc. Georgia Nutr. Conf. p. 116.

6. Murphy, J., W. Brock, and J. Tomlinson. 1989. Bermudagrass okay for dairy cows. MAFES Research Highlights. p. 7.

7. Nat. Research Council. 1989. Nutrient requirements of dairy cattle. 6th ed. Natl. Acad. Sci., Washington, DC.

8. Nelson, B.D., C.R. Montgomery, E.B. Morgan, D.M. Johns, and H.D. Ellzey. 1980. Effects of harvest date and age on quality of Coastal bermudagrass. Louisiana State Univ. Bulletin No, 730.