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COST, ANIMAL PERFORMANCE, AND RECOMMENDATIONS
ASSOCIATED WITH GRASS SILAGE AND GREEN CHOP FEEDING

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Animal Performance, Cost, and Recommendations Associated With Grass Silage and Green Chop Feeding

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INTRODUCTION: The production and utilization of forages will continue to be an important part of the BARTAD project and Caribbean agriculture, and will be the basis of ruminant animal production. Although during approximately one-half of the year, there is sufficient rainfall to bring about relatively high forage yields, forage production during the dry season is reduced by about two-thirds. Therefore, since almost three times more forage growth is available during the wet season than during the dry season, some means of conserving forage for use during the dry season should be included in animal management programs. This is particularly true since grain production generally has not been successful within the BARTAD Project.

There are essentially three ways of conserving forage; as hay, as silage or as accumulated, unharvested growth on the stem. During the planning stages of the BARTAD Project, the need for conserved forages was realized. Silage was selected to be the first method of forage conservation to be studied, since frequent (in some cases daily) rainfall conditions during some seasons are not usually conducive to conserving forage as hay. However, hay has been made successfully in the fall. During the early stages of the silage harvesting and feeding program, conditions were less than perfect for several reasons. However, the limited experiences with harvesting and utilization of grass silage and of feeding direct-harvested forages without ensiling are summarized in this report.

PROCEDURES:

Silage harvesting was accomplished in September, 1974 and September, 1975. The animal performance and cost information contained in this report were from the latter harvesting year and based on harvesting 12 acres of grass silage. The forage was harvested with a direct-cut flail chopper, and self-unloading wagons. Three tractors, two wagons and a flail-type chopper were used. Harvesting and filling the silo (approximately 91 tons) was accomplished with six men. In 1974, the silage was from the first crop of Sudax planted on virgin ground, and the 1975 silage was made from a grass-legume mixture in pastures 3-13A and 3-13B.

The 1974 silage was ensiled in a trench silo approximately 36 feet in width, with silage accumulated to depths of approximately 6 feet. Another type of silo used in 1974 was a bunker type (entirely above ground), approximately 20 feet in width, with sides made of long, debarked pine poles. As will be indicated later, neither of these silos were satisfactory. The silage harvested in 1975 was stored in a trench silo, approximately 20 feet in width, with one side of creosote plank

and the other side of undisturbed earth and rock. The latter silo was more suitable since the smaller exposed silage space more nearly matched the number of animal units being fed silage.

In January, 1976, dry weather reduced the carrying capacity of pastures, and a decision was made to utilize the grass-legume silage in storage. During the winter, three lots of cattle and one lot of sheep were fed grass silage because of a shortage of feed or as part of a research project. Two cattle groups and the sheep flock received supplemental silage on pasture. However, one group of 11 yearling steers were full-fed the mixed grass-legume silage in drylot for 98 days. The observations began on January 20 and ended on April 27, 1976. A trace mineralized salt mixture and sodium biphosphate were provided free-choice in a double compartment mineral box. Water was furnished in a metal trough and the steers had access to a dust bag for insect control. Only the feeding area was covered and the floor of the pen was unsurfaced. Most of the steers were dehorned during the study which caused a brief stress period.

The silage was removed from the trench silo by a combination of hand forking and a front-end tractor loader. Gross weights of the silage fed were usually obtained on a daily basis, but at times the daily feeding amounts were according to volume. The feeding process was not the most desirable for several reasons: a) quantity of silage removed daily was so small that a large amount of spoilage and volatile losses occurred in the silo, b) the floor of the silo was dirt-rock and a considerable amount of this material was mixed with the silage as it was fed, and c) due to efforts to acquire weights of the silage with lack of proper equipment, additional losses in nutritive value and inefficient use of man time resulted.

The animals were group-fed once daily and individually weighed at 14-day intervals. When the daily rate of silage consumption was stabilized, it was estimated that the steers were offered an average of 40 to 50 pounds of silage daily or approximately 45 pounds per head daily for the remainder of the feeding period (this value was to estimate daily consumption rates). A large amount of the silage was picked over and pulled out of the feed troughs, resulting in considerable wastage. Thus, an accurate value for weighback of uneaten silage could not be recorded. A sample of silage was obtained at the beginning and end of the feeding period and subjected to laboratory analysis. These analyses were used to estimate nutrient intakes by the steers.

A green chop trial was conducted with 12 yearling steers fed green chopped forage. The forage was a mixture of elephant grass and guineagrass that was cut with a flail-type harvester. The forage was blown into a self-unloading forage wagon and hauled to the drylot. The feeding period was six weeks in length, beginning on April 27 and ending on June 8, 1976.

The steers were in thin condition at the beginning of the feeding period as they had just finished the drylot silage feeding study described above in which weight gains were not obtained. The volume of green chopped forage offered was not measured and the quality of the feeding material was not determined. However, both grasses were in a medium stage of maturity. Analysis from other trials on these same grasses at comparable stages of maturity were 9.5% crude protein and 59.1% total digestible nutrients. A salt-trace mineral mixture was

provided free-choice in a mineral feeder. The drylot had a dirt floor and contained a roof over the feed trough to protect the feed and provide a small area of shade. The steers were individually weighed at 2-week intervals to determine weight changes.

RESULTS OF SILAGE FEEDING TRIAL:

The results of the silage feeding trial with the ~~12~~ 11 yearling steers were quite disappointing, resulting only in a maintenance level of nutrition, and not a growing or finishing level. The weights recorded at 14-day intervals are presented in Table 1.

Table 1. Weights of Steers Fed Silage in Drylot

Item	Wt., lbs.	Wt. change from initial wt., lbs.
Weigh date		
Initial	556	-
14-day	544	-12
28-day	558	+ 2
42-day	570	+14
56-day	559	+ 3
70-day	562	+ 6
84-day	558	+ 2
98-day (final)	547	- 9

The steers appeared to grow during the trial, but lost some of the original condition (fatness). Prior to the start of the silage-feeding trial, the steers were on fairly high-quality pastures and had started to deposit some finish. An additional factor contributing to their rather high level of condition at the start of the trial was that most of them had been weaned within 2 months before the trial started. The calves were from mature cows apparently producing relatively high amounts of milk and were fleshy when weaned. The silage provided during the trial resulted in a decreased level of energy and available protein compared to the pre-trial feeding conditions, which, in turn, decreased rate of gain and condition, but allowed some skeletal growth.

The laboratory analysis of the silage, averaged over initial and final samples, were: 77% moisture; 8.2% crude protein, 53.2% acid-detergent-fiber;

3.7% ADF-protein, and 50.5% estimated total digestible nutrients. Based on this analysis, relatively low rates of gain were anticipated. A silage containing only 23% dry matter is expected to result in only moderate feed intakes, particularly without treatment with acids at ensiling time. Acid addition would have been costly, but may have resulted in a higher-quality silage. The relatively high amount of heat-damaged protein, 3.7%, which is considered unavailable even to the ruminant, decreased the percent of "available" protein to 4.5%, which is less than the National Research Council recommendations of 12.2% for steers of this weight. Considering the silage protein content, the proportion of legume in the silage must have been rather low.

The silage was fed free-choice once daily. Sufficient amounts were provided so that silage was available to the steers as much of the time as possible. However, large amounts of the silage was not consumed because of spoiling (either in the trench silo or feed trough) and contamination by dirt and stones. Although an average of 45 pounds of silage was offered per head daily, an average refusal of 25% was assumed, resulting in an estimated intake of 34 pounds per head daily.

The animals weighed approximately 550 pounds during the feeding period. Therefore, the NRC requirements listed for a 550-pound steer were used to establish nutrient requirements and estimated nutrient intakes in determining the reasons for the poor performance. Growing yearlings of this type should gain about 0.75 to 1.25 pounds per day on a satisfactory nutrient intake level from forages. By comparing the requirements with the estimated nutrient intake, it is evident that they did not consume enough nutrients to meet maintenance requirements. These differences are presented in Table 2. Calculations were based on the average laboratory analysis of the silage, an intake of 34 pounds of silage daily and the NRC standards as listed by the U. S. National Academy of Science (Publication #4, Nutrient Requirements of Beef Cattle, 1976).

Table 2. Daily Requirements and Estimated Intake from 34 Pounds of Silage

Item	Requirement[a]	Est. intake	% Deficiency
Dry matter, lbs.	9.70	7.82	19.4
Crude protein, lbs.	0.77	0.64	16.9
Digestible protein, lbs.	0.44	0.35	20.5
TDN, lbs.	5.07	3.95	22.1

[a]Requirements for a 550-pound yearling steer for maintenance only. (N.R.C., 1956).

The limiting factor for satisfactory performance seemed to be the high moisture content of the silage which in turn depressed the intake of dry matter, TDN and protein. The low amount of digestible protein in the total crude protein value was disappointing and no doubt affected overall performance. In fact, the value for crude protein in the silage approached a satisfactory level, but a high percentage of this was unavailable, heat-damaged protein.

A further indication of the inferiority of the silage, as ensiled and fed under conditions of this study, was the comparative performance of grazing heifer mates to the silage-fed steers. During the same period, the heifers averaged a per-head gain of 150 pounds, for an average daily gain of 1.53 pounds on similar types of pastures grazed under a frequent rotation program.

RESULTS OF GREEN-CHOP FEEDING TRIAL:

The steers were individually weighed at 2-week intervals to determine weight changes. The steers gained an average of 14 pounds in the first 2 weeks, lost an average of 8 pounds in the second 2 weeks and gained an average of 24 pounds in the final 2 weeks (Table 3). The consistent weight losses in the middle period were assumed to be due to a lack of sufficient quantities of the green chopped material offered. The overall average gains were 30 pounds in the 42-day period, for an average daily gain of 0.71 pounds per head.

The performance of the steers receiving the green chopped forage was quite disappointing because they readily accepted the material and appeared to consume large quantities. In addition to the poor animal performance, the harvesting and feeding practices also caused problems. Two forage wagons and two forage harvesters were available and in good operating condition at the beginning of the study. However, there were times when this equipment could not be used on the scheduled times due to mechanical breakdowns. In fact, there were six major mechanical breakdowns with either the wagon or harvester during the six weeks plus the fact that a back-up tractor was needed on one occassion. Thus, a farmer using green chopped forage under these conditions would essentially have to have duplicate sets of machinery available.

Usually two men were involved in chopping and feeding the forage. This required approximately 1 hour each day for each man or 2 man hours per day. Naturally, the green-chopping program would have been more efficient in terms of labor requirement if more cattle or animal groups were simultaneously receiving direct-cut forage.

SILAGE HARVESTING COSTS:

The costs of harvesting the 12 acres of grass silage in 1975 are detailed in Table 3. Harvesting and filling the silo was completed during three work days with a crew of six people. Three tractors, two wagons and a chopper were used. Wages were calculated at the cost actually paid. Machine costs were taken from Final Report No. 13 "Machinery Cost Analysis." It cost $68.43 per acre or $9.02 per ton to harvest and ensile the material.

Table 3. Estimated Cost of Harvesting 12 Acres of Grass Silage, BARTAD, 1975

Item	Quantity	Rate	Cost
Labor:			
Foreman	15 hrs.	$3.50	$ 52.50
Workers (5)	74 hrs.	2.10	155.40
Machinery:			
Chopping:			
JD 4230	15.2 hrs.	$8.57	$130.26
Chopper	15.2 hrs.	4.63	70.38
Hauling:			
JD 2030	10.3 hrs.	$6.44	$ 66.33
2 Wagons	30.4 hrs.	4.57	138.93
Packing:			
JD 4230	11.0 hrs.	$8.57	$ 94.27
Total Harvesting Costs			$709.07
Costs Per Acre (12 Acres)			59.01
Cost Per Tons (91 tons)			7.98
Cost Per Ton D. M. (20.9 tons)			33.88
Cost Per Pound D.M. (41,800 lbs.)			1.69

SILAGE FEEDING COSTS:

An analysis was made of the cost of feeding grass silage. Because of the small daily volume and the necessity to weigh each load for research purposes, these costs tend to be high and not applicable to a larger-scale production operation. Also the equipment available was not the most suitable. Since several lots of animals were fed for varying periods, the costs were calculated for the 98-day period and prorated to the steer feeding trial on an animal unit per day fed basis. The estimated daily cost per animal was 42.6¢ (Table 4).

TOTAL SILAGE COSTS:

To complete an analysis of the desirability of utilizing grass silage, it is necessary to combine costs for growing and storing the silage with the

harvesting and feeding costs. The estimated costs for growing forage are reported in Progress Report #18 - "An Analysis of The Cost of Pasture Production." The lowest cost of forage estimated was 2.88¢ to produce a pound of dry matter (Table 5).

The storage cost was calculated by using 25% depreciation on the cost of construction for the silo. To this was added the cost of a plastic tarp and 15% spoilage loss in the material put into the silo. This gave a storage cost of 2.5¢ per pound of dry matter (Table 5).

When the costs for producing, harvesting, storing and feeding the grass silage were combined, total costs were 13.8¢ per pound of dry matter.

Table 4. Costs of Feeding 51.37 Tons Grass Silage in 98 Days, BARTAD, 1976

Item	Rate	Cost per day
Labor:		
Two men 3 hrs.	$2.10	$ 6.30
Equipment:		
JD 2030 - $1\frac{1}{2}$ hrs.	$6.44	9.66
Total Cost		$15.96
Cost for 98 days		$1,564.08
Cost Per Pound of D.M.:		
$\frac{\$1,564.08}{23,373^a}$		6.69¢
Cost/Animal Unit/Day Fed:		
$\frac{\$1,564.08}{3674 \text{ (Animal Unit Feeding Days)}^b}$		42.6¢

[a]51.37 tons x 22.75% dry matter = 23,373 lbs.
[b]Three lots of cattle and one lot of sheep were fed and the costs prorated.

Table 5. Costs of Producing, Harvesting, Storing and Feeding Grass Silage to a Steer for 98 Days, BARTAD, 1976

Item	Dry Matter Intake	
	One Pound	1024 Pounds
Growing Costs[a]	$0.029	$ 29.70
Harvesting Costs	0.017	17.41
Storage Costs[b]	0.015	15.36
Feeding Costs[c]	0.067	68.61
Total Costs	$0.128	$131.08

[a]For the cheapest legume-grass pasture mixture in feasibility plans.
[b]25% depreciation + plastic tarp + 15% spoilage.
[c]Feed research animals require more time because feed must be weighed.

To analyze the costs and benefits of this feeding trial the costs were applied on a per head basis using the 1024 pounds of dry matter fed on an average to each steer during the 98-day period. Total costs came to an estimated $131.08 per head fed for this 98-day trial. However, relatively high dry matter losses in the silo and refusals at the feed bunk, higher labor costs because of the research nature of the trial, and the lack of needed supplementation of additional energy and protein, contributed to the lack of economic feasibility of silage.

CONCLUSIONS:

The analysis of these experimental data is not very encouraging. Since the steers showed an average net loss of nine pounds per head, it is reasonable to assume that they did not increase in value. However, in the case of brood cows, all that is desired is to maintain weight. In addition, the protein and energy requirements of mature cows would be more nearly commensurate with quality of the silage in this study. The production and labor costs presented in this publication are relatively high as compared with the United States, primarily because of the small-scale of the silage harvesting and feeding operation and the research nature of the project. Even if the steers had gained 75 pounds per head during the period, a value of 60¢ per pound would only give a return of $45 as compared to a cost of $131. Perhaps higher quality silage (higher dry matter and protein content) and better, more rapid ensiling and packing would improve the ability of the steers to utilize the feed. Even so, the anticipated benefits would probably not justify harvesting grass silage unless the cost can be materially lowered or as a strictly emergency feed source. Local small-scale farmers cannot be encouraged to use grass silage of this quality for yearling

cattle as a regular production practice unless the cost: benefit ratio can be improved. There may be a possibility of wilting silage (decreasing moisture content and increasing the probability of a more desirable fermentation) and storing in large-scale silos at the Farmer Cooperative level for emergency use.