Coastal Bermuda Pastures Compared with Other Forages for Dairy Cows

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CONTENTS

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PASTURE USUALLY is the cheapest feed for dairy cows. The role of pasture in soil conservation is well known. However, nutritive value of the forage, yield, palatability, and ability to survive when grazed are important points to consider when selecting pasture crops.

In most cases lactation performance of cows grazing legume or grass-legume forages is superior to that of cows on grass. Throughout much of Alabama, efforts to provide legume or legume-grass pastures for summer grazing have not been successful. Thus, perennial and annual grasses are the main source of summer pasture.

In the search for a high quality perennial summer grass, Coastal Bermuda, *Cynodon dactylon* (L.) Pers., has shown promise. It is well adapted in Alabama and responds to high levels of nitrogen fertilization *(6)*. Yields approaching 10 tons of dry forage per acre are possible on a wide range of soil types if enough fertilizer is used *(2)*.

To maintain good milk flow in the summer, dairymen often use such annual crops as Starr millet and Sudangrass. Millet pasture

* The work of W. R. Langford, Agronomist, now with the Southern Regional Plant Introduction Station, Experiment, Georgia, in the early phases of this experiment is acknowledged.

in the Southeastern States has generally resulted in good milk production *(5, 9)*. Gahi-1, a new millet variety, has been found to be more productive than Starr millet *(7)*. These temporary grazing crops require soil preparation each year and are expensive to establish.

Harvested forages, such as alfalfa hay and corn silage *(4)*, may be used for summer milk production or at least to supplement permanent pastures. The nutrients from hay and silage are more costly than those from pasture.

Certain management practices have been shown to affect lactation performance. Results of research in Sweden *(11)* showed that milk yield per cow per day was lower where the animals were kept indoors at night than where cows had access to pasture day and night. In that study cows on pasture only in the daytime grazed more intensively than cows pastured both day and night.

Studies have been made on the behavior of cattle in day and night pastures of the same forage species. English workers *(1)* concluded that cows need day and night paddocks of equal size and herbage of similar quality. Similar conclusions were reached in Virginia *(3)*. However, in the latter study it was found that the least grazing was done between 8 p.m. and 11 p.m. Work in the Fiji Islands *(10)* indicated that dairy cattle in the tropics should be put in the best pasture at night and early morning hours since grazing is reduced during the hot daytime hours.

Summer grazing studies were conducted at the Dairy Research Unit of Auburn University Agricultural Experiment Station each year from 1956 through 1961. The main objectives were:

(1) To compare three common summer perennial pasture grasses for milking cows. The grasses tested, with and without irrigation (1956-57), were Coastal Bermuda, Pensacola Bahia, *Paspalum notatum* Flugge, and Dallis, *Paspalum dilatatum* Poir.

(2) To compare Bermuda and Bahia, under continuous and rotational grazing management, with alfalfa hay (1958). This study was developed after evaluating results of the first 2 years.

(3) To compare Bermuda with millet, *Pennisetum glaucum* (L.) R. Br., (1959) after Bermuda proved superior in yield to Bahia during the first 3 years.

(4) To evaluate clipping as a method of improving quality of Bermuda and millet pastures (1960-61).

EXPERIMENTAL PROCEDURE

General

All of the studies were of the split plot, randomized block design with three or six replications, except the 1958 studies were of the Latin-square design.

Six 1½-acre paddocks each of Bermuda, Bahia, and Dallis grasses were established on Cecil clay loam, a droughty soil with rough topography. Lime was applied according to soil test and fertilizer at the annual per acre rate of 1,000 pounds of 0-12-20 during the years 1956-58 and 500 pounds of 0-14-14 thereafter. This was more than the actual mineral needs of the grasses, but the high rate was used to be certain that phosphorus and potassium were not limiting factors in the experiments.

All groups of experimental animals had access to pasture from 6:30 a.m. to 9:30 a.m. and were confined to pasture at night. In addition to the tester cows, additional animals were used to graze surplus forage during periods of rapid growth of pasture grass. Pasture forage was supplemented with a 16 per cent protein concentrate mixture (corn, oats, and cottonseed meal) at the level of 1 pound to each 4 pounds of 4 per cent milk (FCM). Milk weights were recorded for each milking and 48-hour composite butterfat tests were made each 2 weeks. Bodyweight changes were recorded in all the studies.

Forage yields were determined by the cage-difference technique. Forage quality was measured by chemical analyses of samples taken from caged and uncaged areas, by intermittent digestion trials, and by measuring milk production level of cows consuming the forage. Intake and digestibility of the forages were determined by the chromogen-chromic oxide method.

Bermuda vs. Bahia vs. Dallis (1956-57)

In 1956 experimental pastures received nitrogen at the rate of 200 pounds per acre for the growing season. This was spread in split applications at 6-week intervals. In 1957 the procedure was the same except that nitrogen was applied every 4 weeks. The paddocks were irrigated during dry periods. Cows were grazed continuously.

Bermuda vs. Bahia vs. Alfalfa Hay (1958)

Since Dallisgrass stands were poor and yields were low after 2 years, Bermuda and Bahia were the only two grasses studied in

1958. They were compared under rotational and continuous grazing with alfalfa hay as the only forage for milking cows.

The paddocks under rotational grazing were divided into sub-paddocks and cows were rotated to a fresh sub-paddock weekly. Each paddock was completely grazed at least once each 3-week period. Nitrogen was applied to pastures at the rate of 50 pounds per acre at 6-week intervals from April 1 to August 5. The 5 × 5 Latin-square design was used. Fifteen cows were put on a standardization treatment for 2 weeks and then divided into three comparable groups of five cows each. The cows within these treatments were assigned at random to the following five treatments:

Alfalfa hay fed free-choice in dry lot,
Coastal Bermuda grazed continuously,
Bahia grazed continuously,
Bahia grazed rotationally, fresh sub-paddock weekly,
Bermuda grazed rotationally, fresh sub-paddock weekly.

The experiment included five 3-week periods beginning May 14 and ending August 26.

Bermuda vs. Gahi-1 Millet (1959-60)

In 1959 a study was made of the performance of dairy cows grazing Bermuda and millet concurrently. Twenty-four cows were divided into four comparable groups of six. The cows in the various groups were assigned to the following treatments:

Coastal Bermuda grazed day and night,
Bermuda grazed day, millet grazed at night,
Millet grazed day, Coastal Bermuda grazed at night,
Millet grazed day and night.

An effort was made to provide high quality forage by applying 50 pounds nitrogen per acre, mowing the Coastal Bermuda to a height of 8 inches and millet to a height of 12 to 14 inches at 3-week intervals, and irrigating during dry periods and grazing rotationally. Each 1½-acre paddock was divided into three sub-paddocks and the cows were rotated to fresh sub-paddocks each week.

In 1960, 18 cows were divided into 3 comparable groups of 6 and assigned to the following treatments:

Coastal Bermuda grazed day and night,
Millet grazed day, Coastal Bermuda at night,
Millet grazed day and night.

Pastures were treated as in 1959 except the Bermuda was clipped each 3 weeks to an approximate height of 4 to 6 inches.

Pasture Clipping Management Study (1961)

Various heights of clipping were studied in 1961. Four comparable groups of six cows each were assigned to the following treatments:

Coastal Bermuda not mowed,

Bermuda mowed to a 4-inch height,

Bermuda mowed to an 8-inch height,

Gahi-1 millet mowed to a 12-inch height.

Small paddocks of one-half acre were used and cows were rotated to a fresh paddock each week; thus, each paddock was grazed every third week. After grazing, the paddocks were clipped and nitrated at the rate of 50 pounds of N per acre. All pastures were irrigated during dry periods.

RESULTS

Bermuda vs. Bahia vs. Dallis (1956-57)

Figures 1 and 2 show the crude protein content of the three grasses by periods from May 21 to November 12, 1956 and May 7 to October 21, 1957. The crude protein content of the grasses varied from low values of 8 to 9 per cent to highs of 15 to 18 per cent on a dry matter basis. The highest values occurred in early summer. However, even in late summer crude protein content of the grass forage was relatively high. There was no difference in protein content of the three species and no difference between irrigated and non-irrigated grasses. A total of 8 inches of irrigation water was applied in 1956 and 16 inches in 1957. Caged samples were taken on the same dates throughout the summer and were similar to the uncaged samples in protein content.

Digestion trials in the summer of 1957 showed that protein digestibility was lowest in Bermuda. The coefficient of digestibility of protein was 36 per cent for Bermuda as compared with 52 per cent for Bahia and 42 per cent for Dallis. Thus, even when the total protein content of Bermuda was 8 to 10 per cent in July and August, the digestible protein content was only about 3 to 4 per cent.

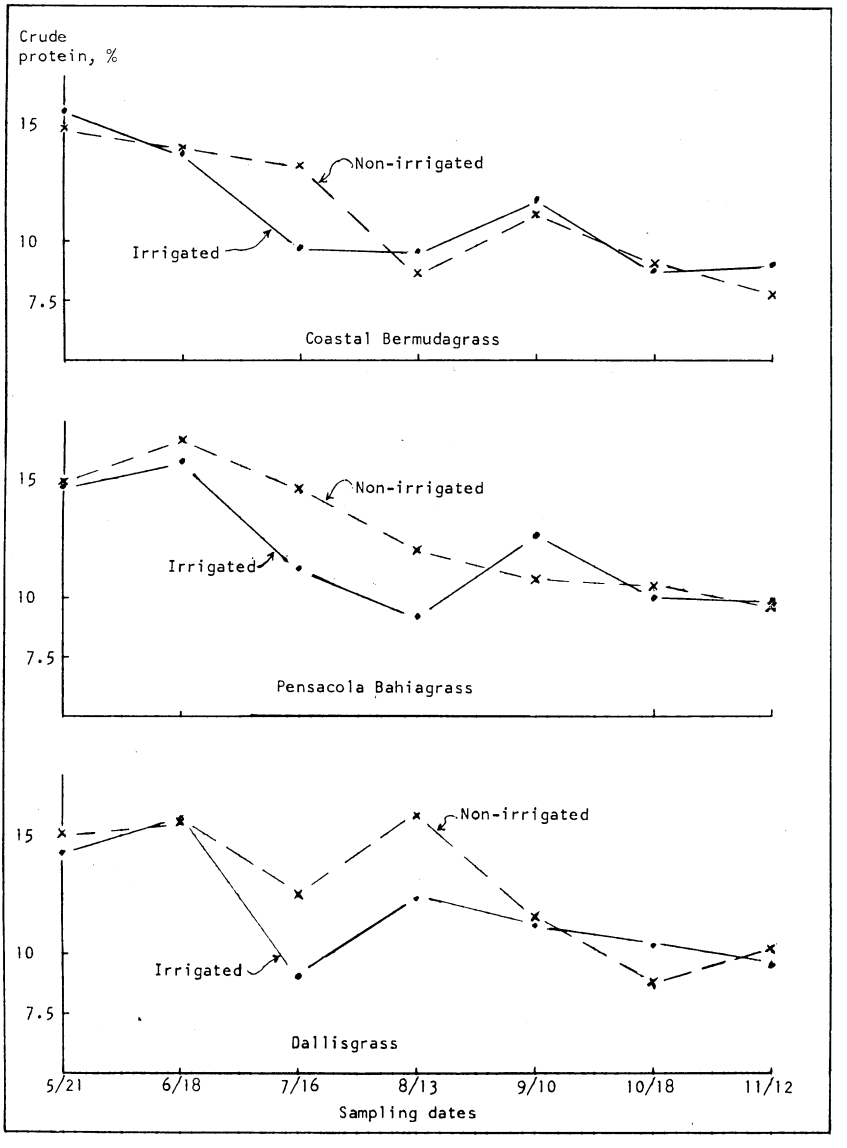

FIG. 1. Seasonal trend in crude protein content of irrigated and non-irrigated grasses at 28-day intervals from uncaged areas, 1956.

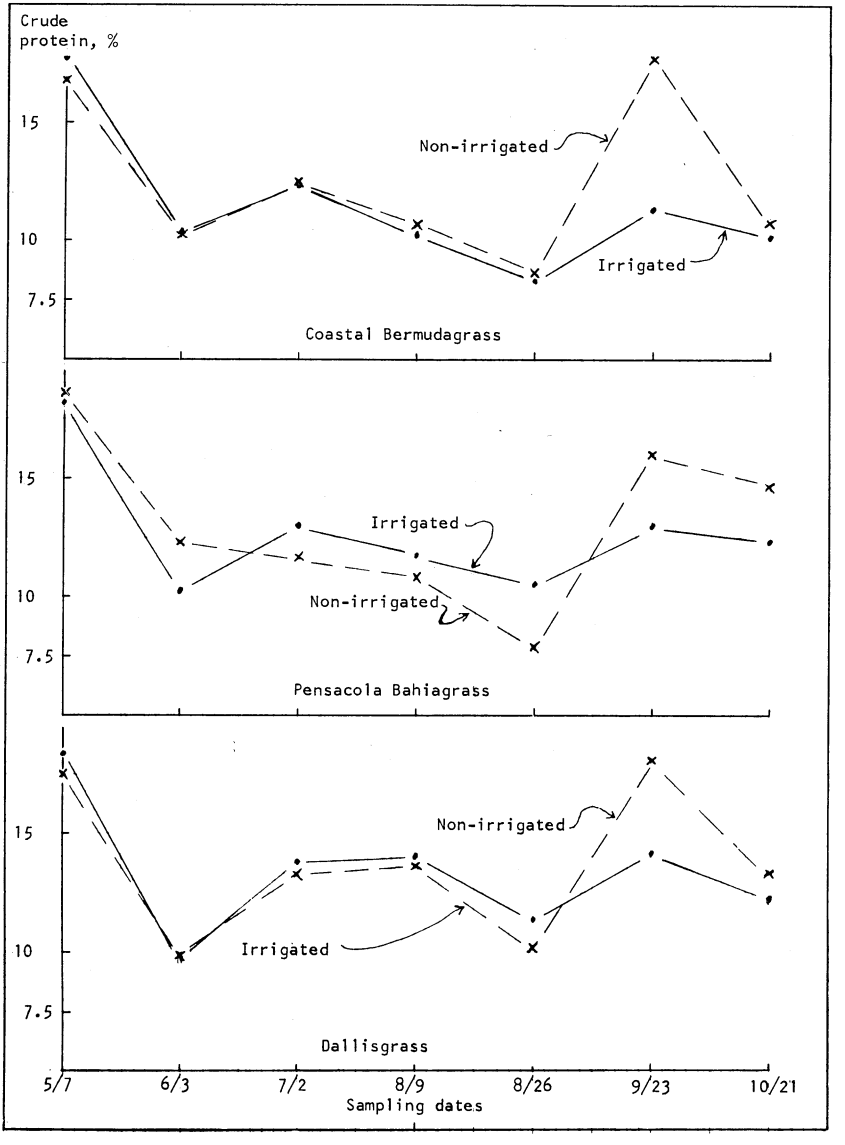

FIG. 2. Seasonal trend in crude protein content of irrigated and non-irrigated grasses at 28-day intervals from uncaged areas, 1957.

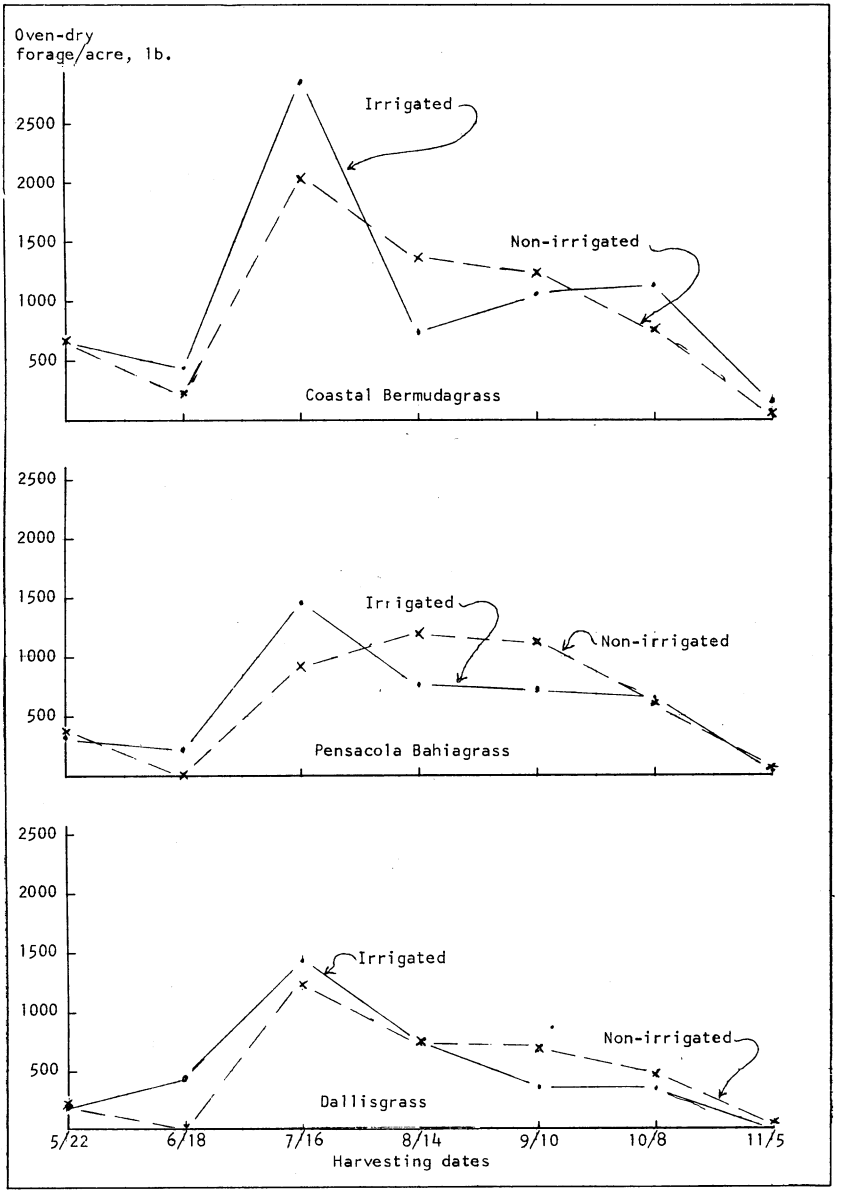

FIG. 3. Seasonal trend in oven-dry forage yield per acre from irrigated and non-irrigated grasses, 1956.

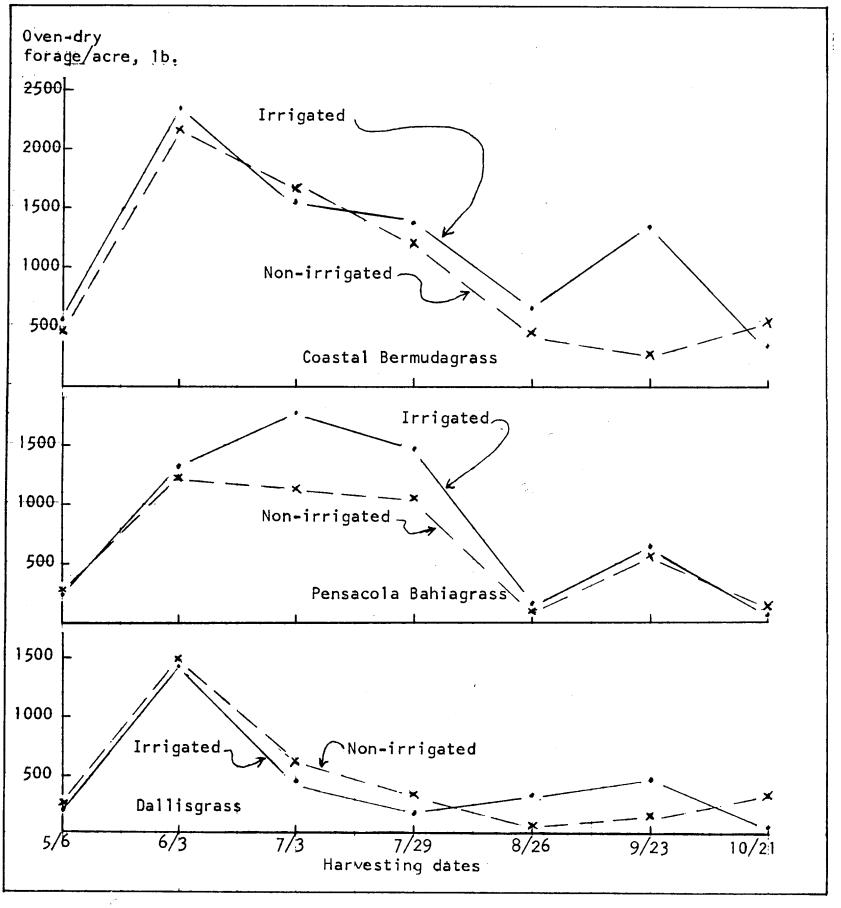

FIG. 4. Seasonal trend in oven-dry forage yield per acre from irrigated and non-irrigated grasses, 1957.

Forage yields of Bermuda in 1956 and 1957 were considerably higher than that of Bahia and Dallis, Figures 3 and 4. In 1956 irrigation water applied in June and July slightly increased forage production during that period. Both Bahia and Bermuda responded to irrigation in 1957. Dallis stands were poor and total production for the season was not increased by irrigation.

Figures 5 and 6 show changes in TDN yields by 28-day periods for 1956 and 1957, respectively. TDN yields were calculated according to Knott's formula (8), which allows for milk yield, gain or loss in bodyweight, and amount of nutrients from concentrates fed. In 1956 there was little response to irrigation by Bermuda

and Dallis. However, irrigated Bahia produced about 50 per cent more TDN than the non-irrigated Bahia. TDN yields of all three grasses were higher in 1957 than 1956. Bermuda yielded about 29 per cent more forage than Bahia, and Bahia 47 per cent more than Dallis. Irrigation of Bermuda and Bahia resulted in a TDN yield increase of approximately 48 per cent in 1957. Irrigated Dallis yielded only 18 per cent more TDN than the non-irrigated; however, this species was more severely affected by dry weather than the other grasses.

Digestion trials in 1957 showed TDN values for Bermuda of about 55 per cent. This compares with about 60 to 62 per cent for Bahia and Dallis. Forage dry matter intake per 100 pounds bodyweight during June and August test periods averaged 2.10 pounds for Bermuda, 2.58 for Dallis, and 2.82 for Bahia.

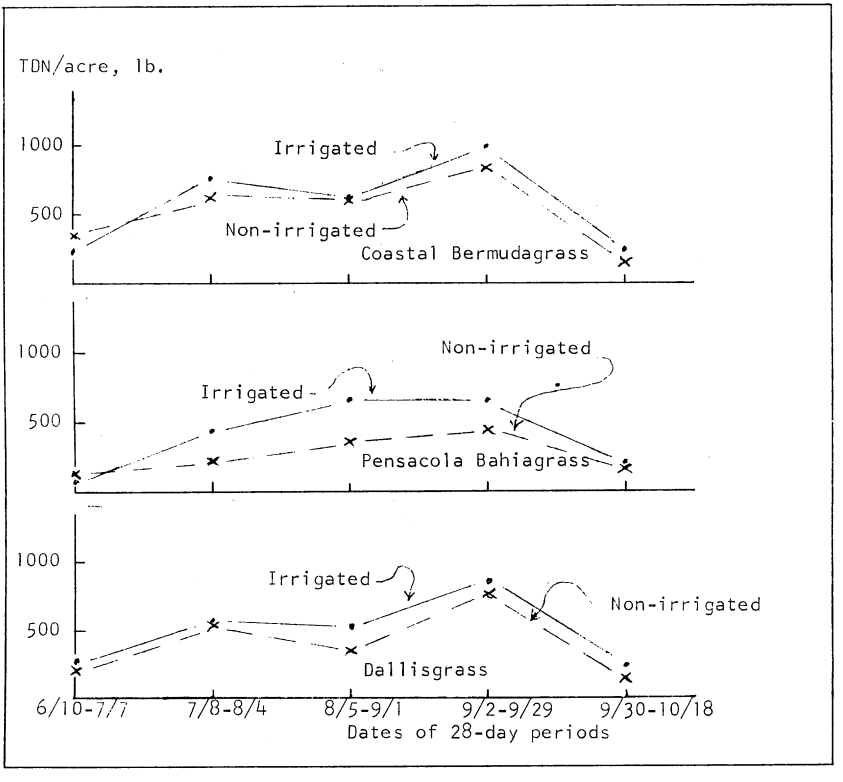

FIG. 5. Seasonal trend in TDN yield per acre from irrigated and non-irrigated grasses, 1956.

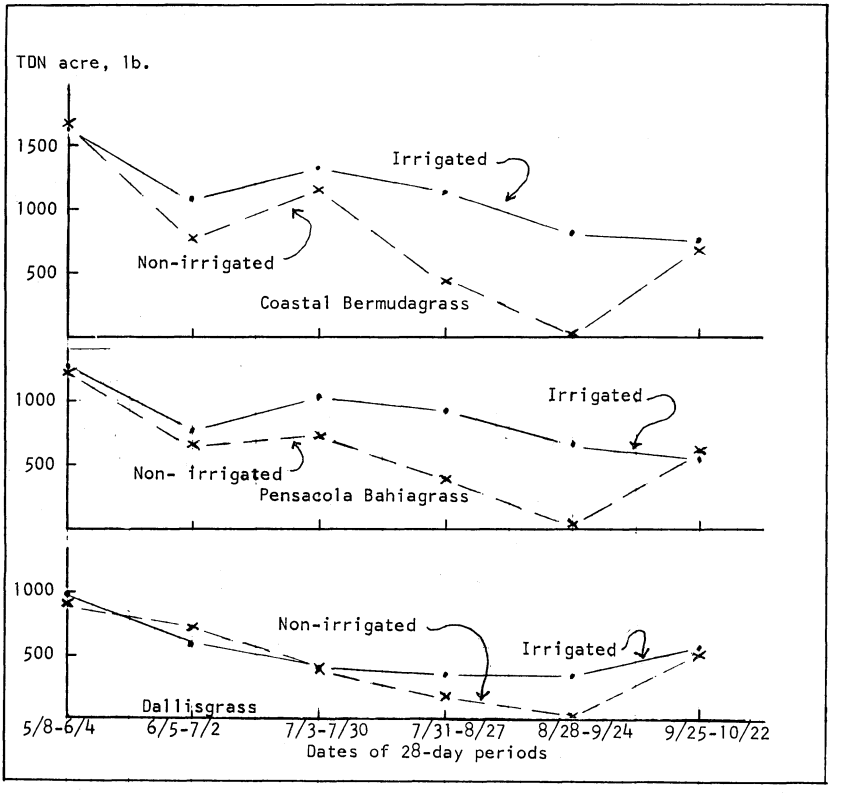

FIG. 6. Seasonal trend in TDN yield per acre from irrigated and non-irrigated grasses, 1957.

Average daily milk production yields per cow are shown in Figures 7 and 8. In neither year were there differences among the three grasses in milk yield. However, persistency of lactation was poor on all three forages. Milk production of cows on irrigated pasture was more persistent than the production of those on non-irrigated pasture during periods of low rainfall.

Severe dry weather from late July to September, 1957, made it necessary to remove test cows from non-irrigated pastures for about 28 days when forage was nil. This loss of grazing on non-irrigated paddocks is indicated by the incomplete curves in Figure 8. It is important to note that irrigation prevented the interruption of grazing caused by the August drought. Given in Table 1 are rainfall levels by months in 1957 and the amount of irrigation water applied from June through September on irrigated paddocks.

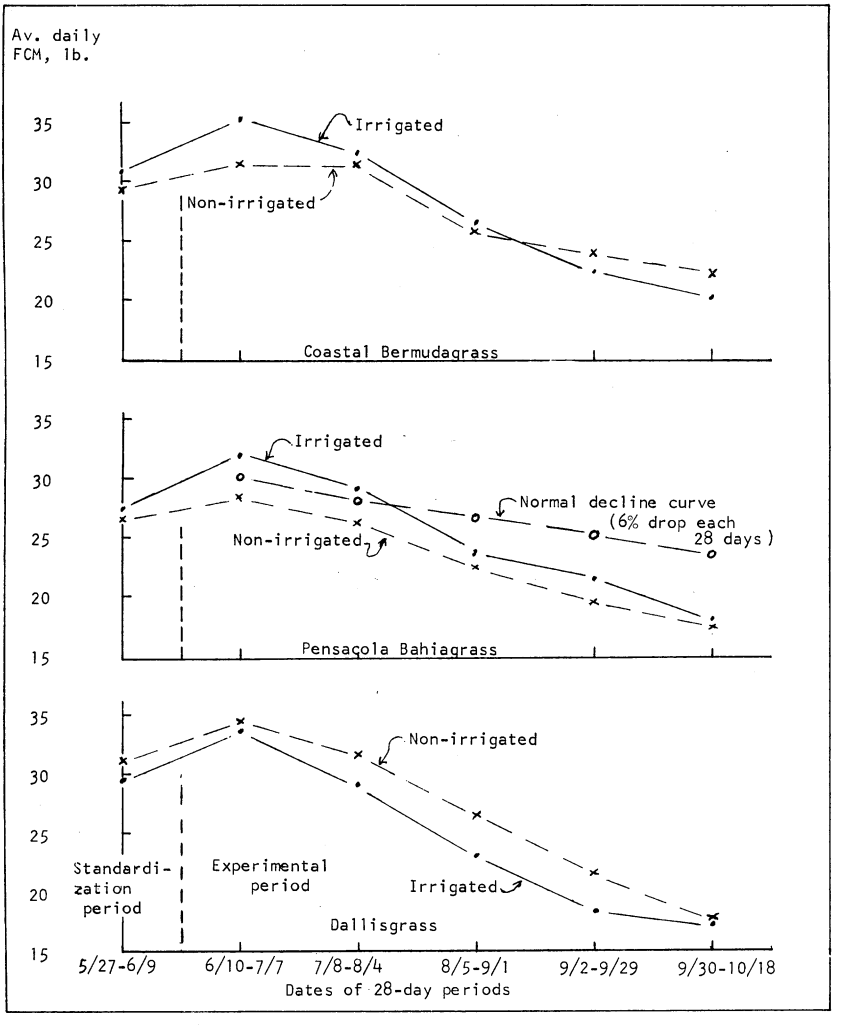

FIG. 7. Seasonal trend in average daily 4 per cent FCM production per cow on irrigated and non-irrigated grasses, 1956. (Each point in experimental period is average of a 28-day period, except the 9/30-10/18 average is for 19 days only.)

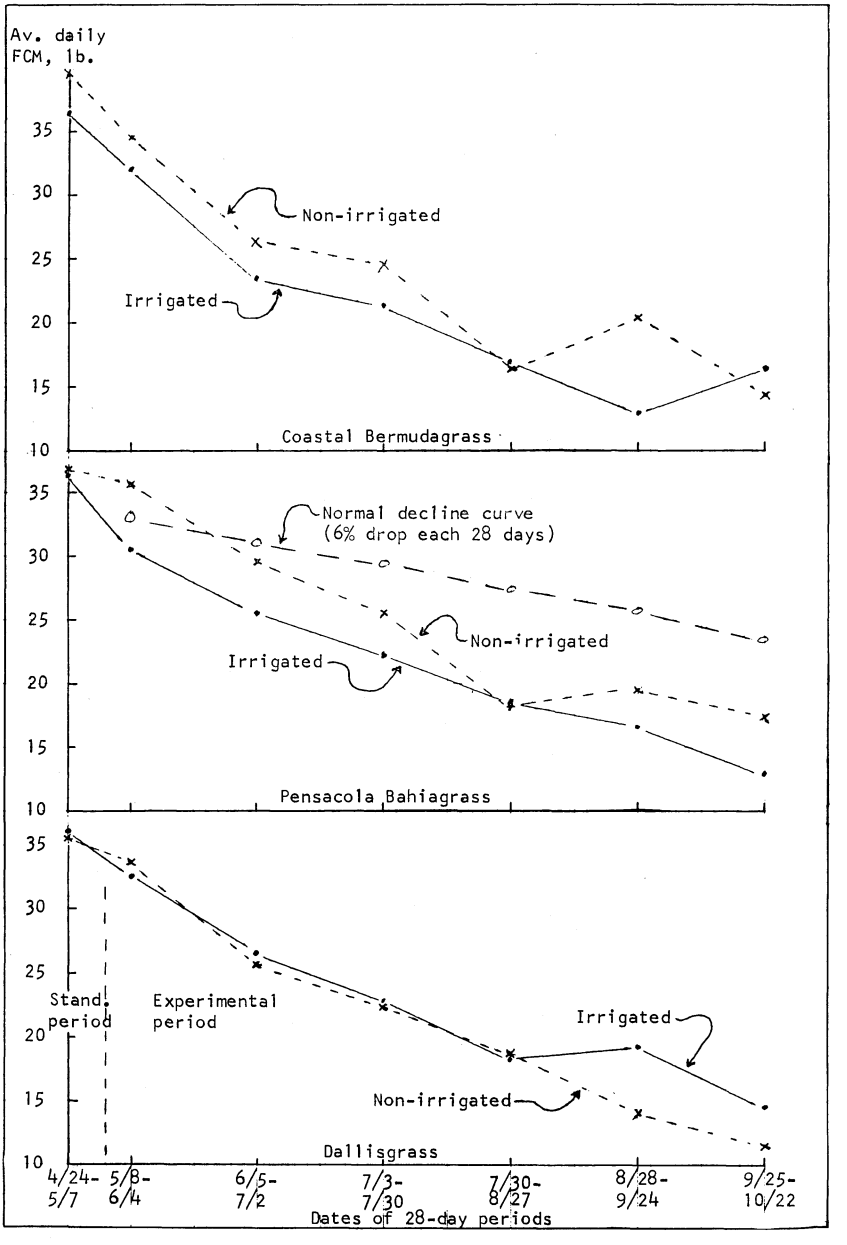

FIG. 8. Seasonal trend in average daily 4 per cent FCM production per cow on irrigated and non-irrigated grasses, 1957.

TABLE 1. MONTHLY RAINFALL AND IRRIGATION WATER APPLIED TO WARM SEASON PASTURES IN 1957

Month	Rainfall	Irrigation
	In.	*In.*
January	4.1	0
February	3.1	0
March	5.1	0
April	11.5	0
May	6.0	0
June	8.0	2.0
July	6.9	4.0
August	0.2	8.0
September	6.9	2.0
October	2.3	0

Bermuda vs. Bahia vs. Alfalfa Hay (1958)

The crude protein content of pasture forages by periods is shown in Figure 9. These data present a striking decline in protein content of the grasses with the advance in season regardless of treatment.

Forage yields of Bermuda averaged about 57 per cent higher than Bahia for the entire season, Figure 10. As in 1956 and 1957, calculated yields of TDN were greater for Bermuda than for Bahia.

The milk production level and persistency of production were higher on alfalfa hay than on any of the pasture treatments, Table 2.

TABLE 2. MEAN DAILY FCM AND PERSISTENCY OF PRODUCTION, 1958

Species and management	FCM[1]	Persistency[2]
	Lb.	*Pct.*
Coastal Bermudagrass		
Continuous grazing	31.5[3]	82[4]
Rotational grazing	32.2	84
Pensacola Bahiagrass		
Continuous grazing	32.7	85
Rotational grazing	32.4	85
Alfalfa hay	34 0	89

[1] Each value is an average for three cows for 15 weeks.

[2] Persistency is expressed as per cent of level of production for the previous month.

[3] L.S.D. (.05) = **0.91**; L.S.D. (.01) = **1.33.**

[4] L.S.D. (.05) = **2.45**; L.S.D. (.01) = **3.57.**

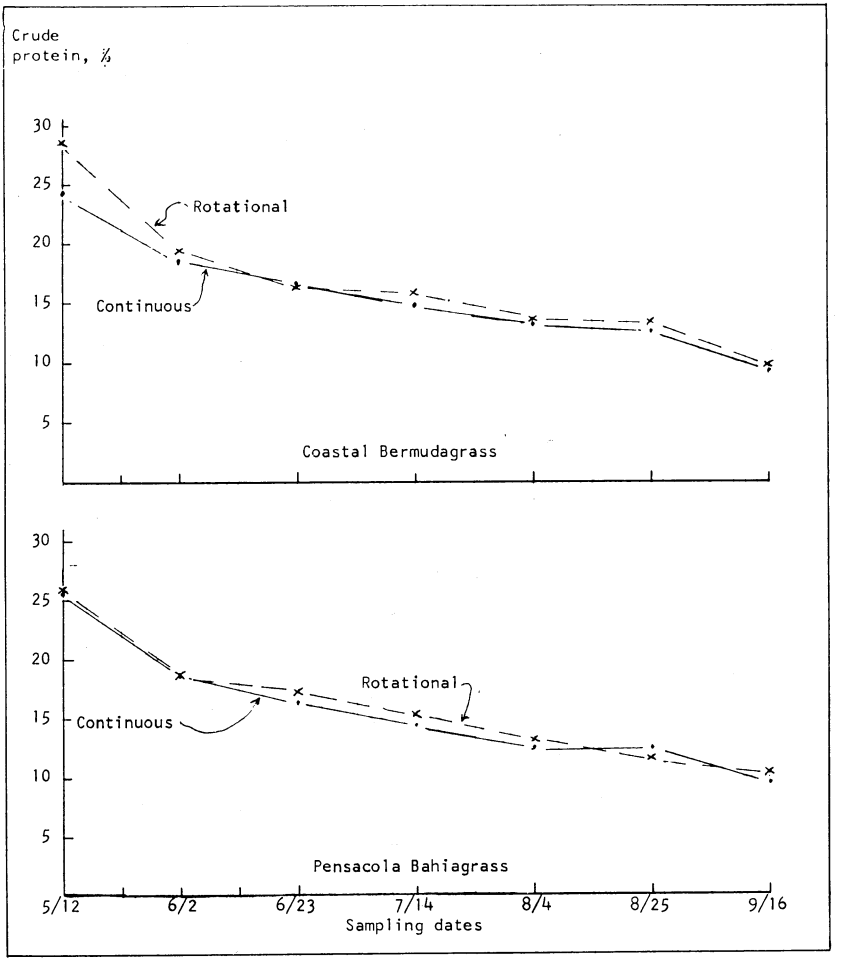

FIG. 9. Seasonal trend in crude protein content of Bermuda and Bahia under continuous and rotational grazing, 1958.

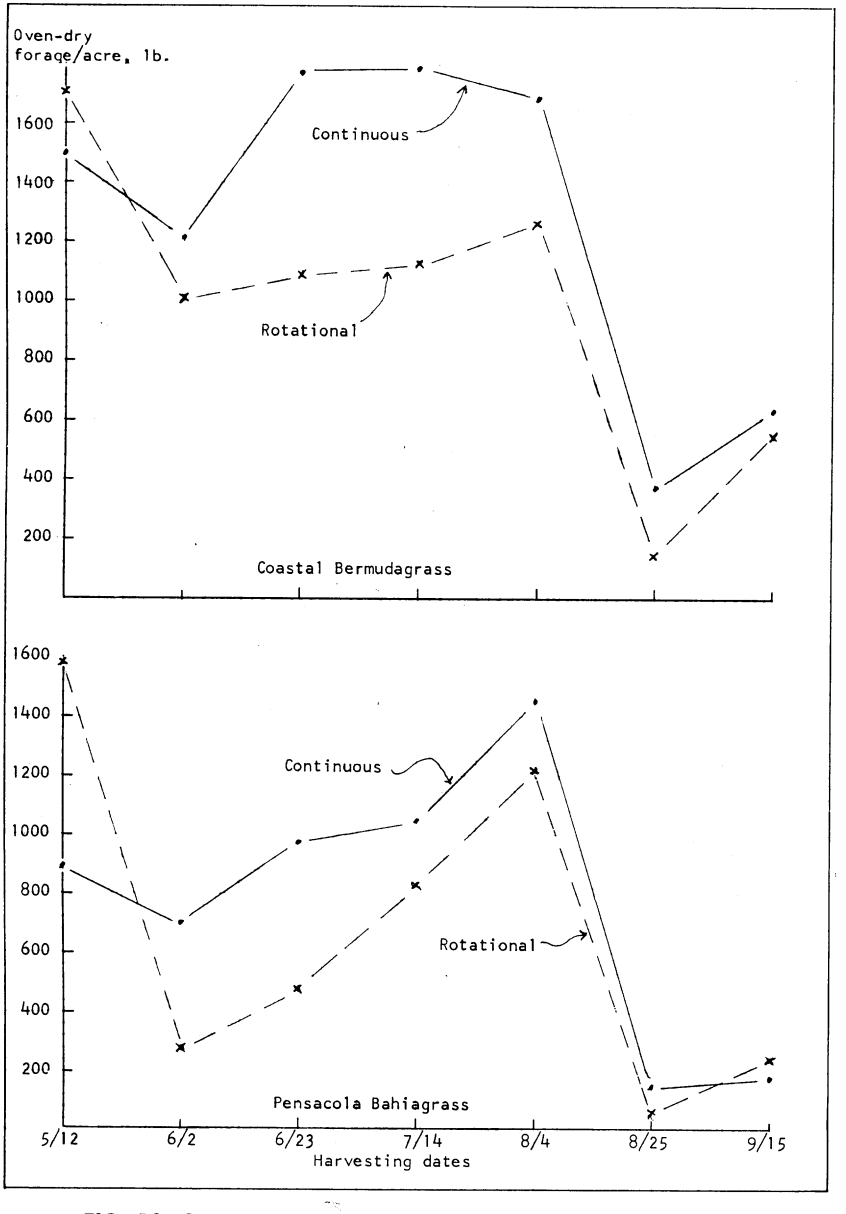

FIG. 10. Seasonal trend in oven-dry forage yield per acre, 1958.

Bermuda vs. Gahi-1 Millet (1959-60)

The crude protein content of Bermuda and millet by weekly intervals in 1959 is shown in Figure 11. The millet forage was consistently higher in protein content than Bermuda, though the protein content of the Bermuda was uniformly quite high throughout the summer. Seasonal average protein content of Bermuda was 13.6 per cent and that of millet, 16.9 per cent.

Figure 12 shows milk production curves of the four treatments throughout the experiment, June 25-September 17, 1959. Milk production dropped an average of 12 per cent per month on Bermuda during the experiment. The corresponding rate of decline on millet was only about 3 per cent. Under good feeding conditions a monthly decline of 6 to 8 per cent in level of milk flow is considered normal.

Cows grazing millet and combinations of Bermuda and millet milked at higher levels than did those on Bermuda alone. How-

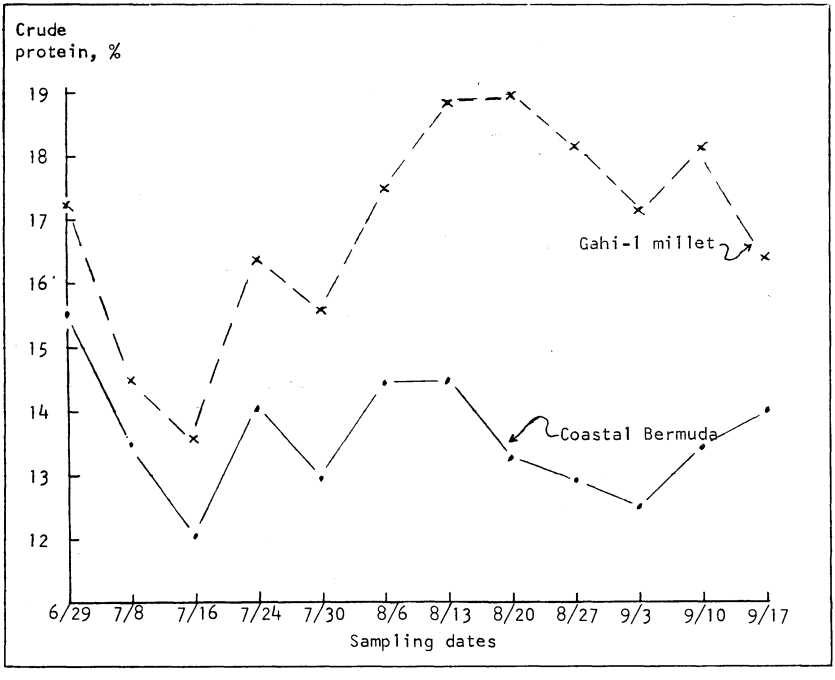

FIG. 11. Seasonal trend in crude protein content of Bermuda and millet pasture, 1959. (Each value = composite of samples from six paddocks.)

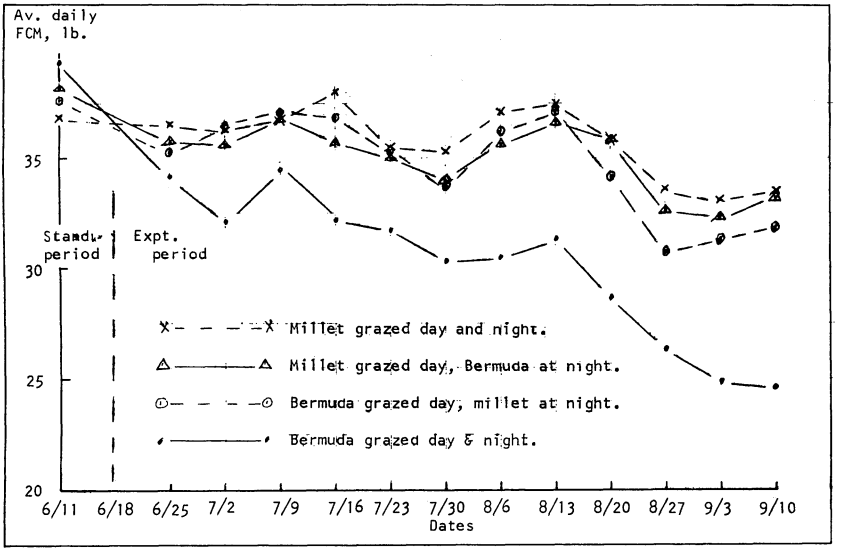

FIG. 12. Mean daily 4 per cent FCM production per cow on Gahi-1 millet and Coastal Bermuda, 1959. (Each point is average daily production of 6 cows for 1 week.)

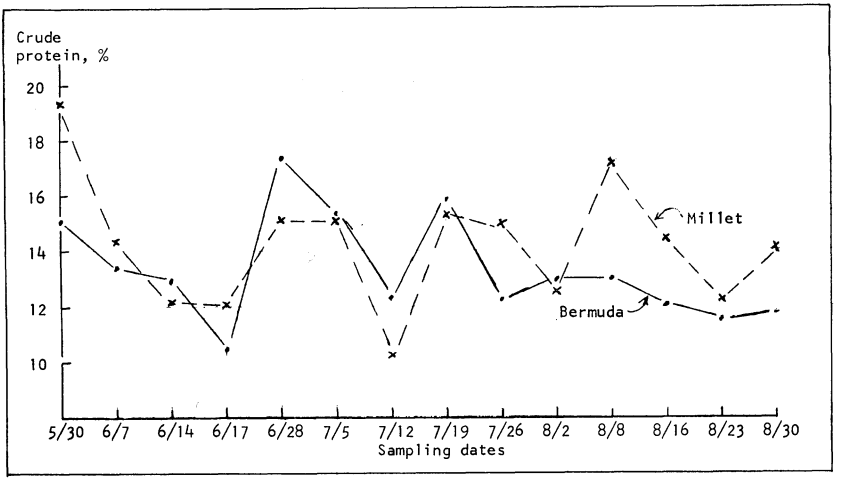

FIG. 13. Seasonal trend in crude protein content of Coastal Bermuda and Gahi-1 millet pasture, 1960. (Each value = a composite of samples from three paddocks.)

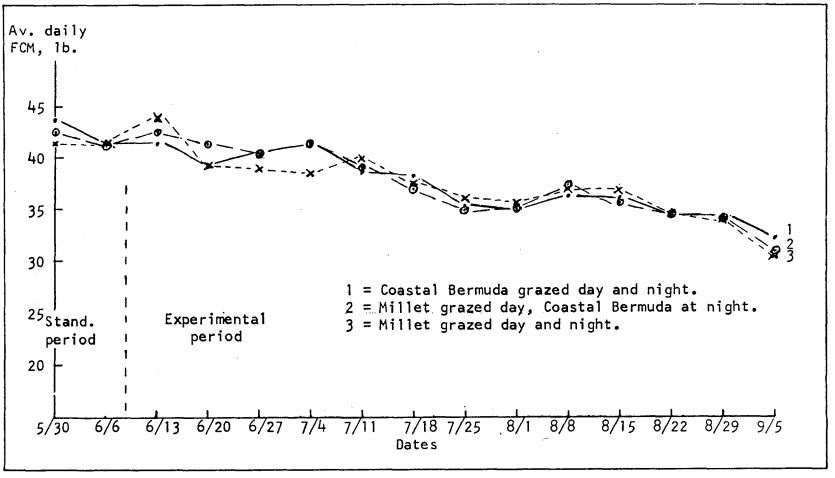

FIG. 14. Mean daily 4 per cent FCM per cow on the three grazing treatments, 1960. (Each point = weekly average of 6 cows.)

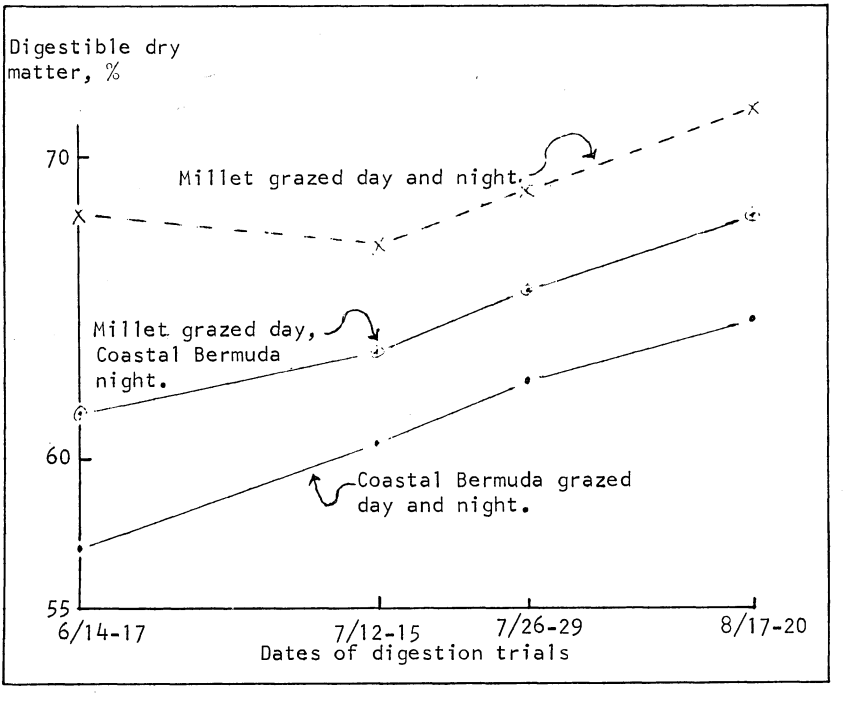

FIG. 15. Seasonal change in digestibility of forages, 1960.

ever, the differences between millet and combinations of Bermuda and millet were small.

In 1960 crude protein content of the Bermuda varied more from week to week than in 1959, Figure 13. Average protein content of 13.4 per cent for the summer was about the same as in 1959, but protein in the millet, 14.3 per cent, was slightly lower in 1960 than in 1959. There were no differences among the three treatments on the basis of milk production levels. Figure 14 shows milk production trends throughout the summer. The average monthly rate of decline of about 8 per cent is near normal and indicates uniformly high quality forage was available to the cows on all treatments throughout the summer. Other evidence of the high quality of the forage is found in the high level of digestibility of the forage dry matter during the summer, Figure 15. Estimates of digestibility of the forages were made four times, the first being June 14-17 and last August 17-20. The unusual increase in digestibility of forage is difficult to explain. The pasture management in 1960 – rotational grazing, clipping surplus forage, irrigation, and split nitrogen applications – probably contributed to forage quality.

An attempt was made to determine whether the cows were

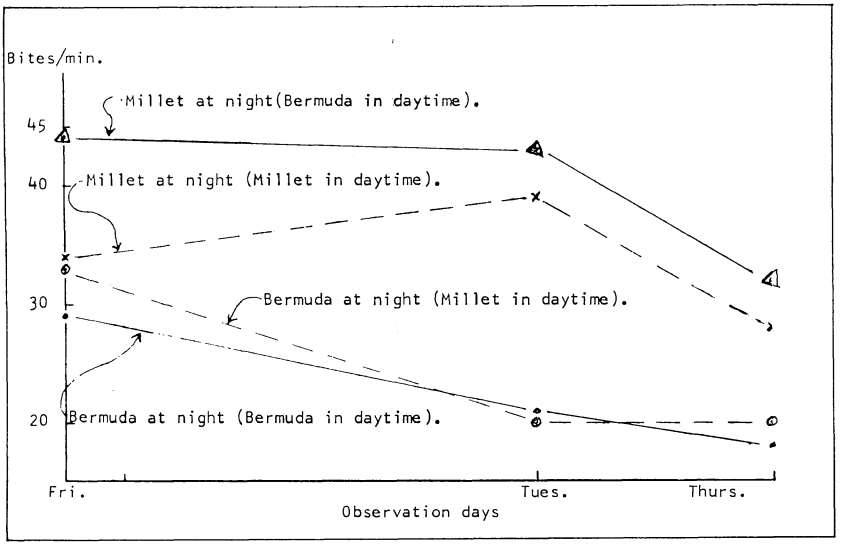

FIG. 16. Bites per minute by dairy cows at the beginning of grazing periods at night, 1959. Each figure is an average of observations of 6 cows.

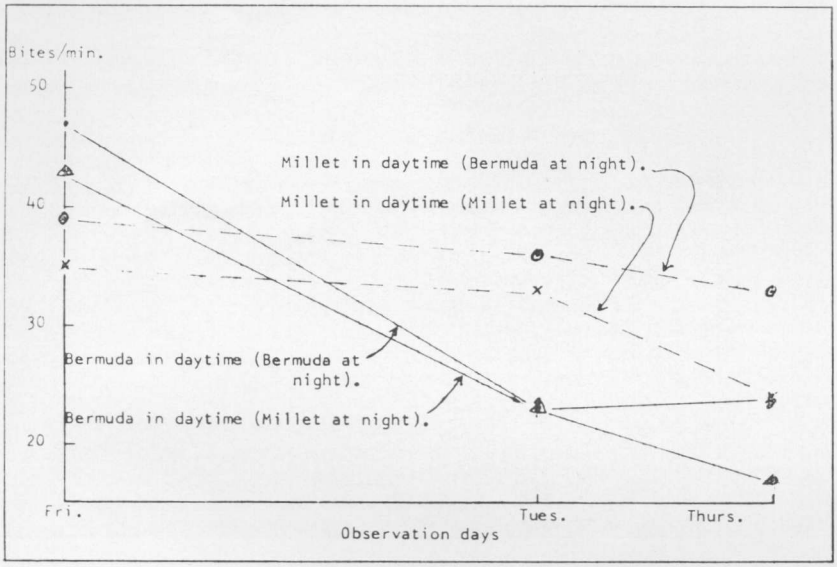

FIG. 17. Bites per minute by dairy cows at the beginning of grazing periods during day, 1959. Each figure is an average of observations of 6 cows.

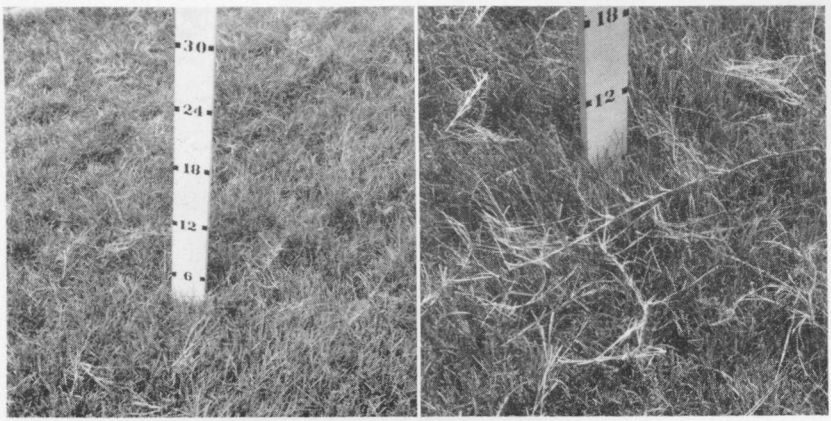

FIG. 18. Appearance of Coastal Bermudagrass after 1 week of grazing is illustrated here. Pasture at left was mowed to a height of 4 to 6 inches 2 weeks before grazing was begun. Plot at right was mowed to 8-inch height 2 weeks ahead of grazing. Note stolons that were rejected by the cows.

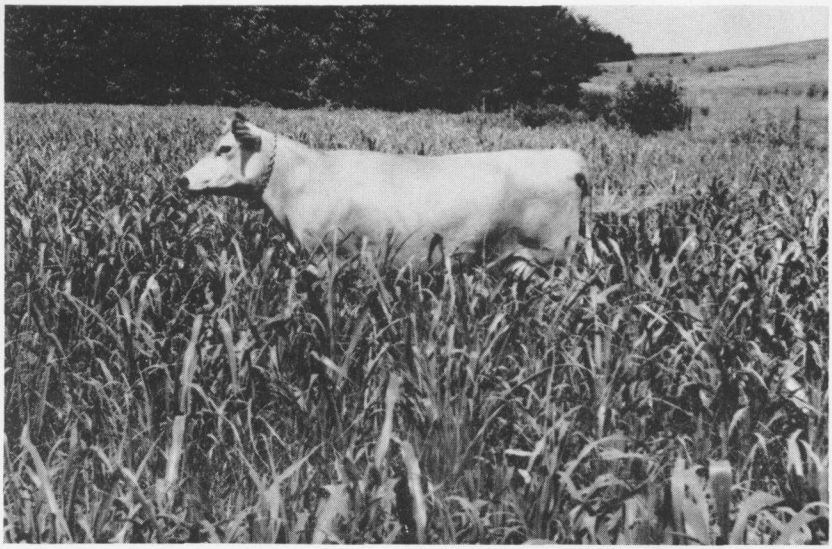

FIG. 19. This is Gahi-1 millet regrowth in a paddock that had been grazed and mowed 2 weeks before the photo was made, 1959.

grazing Bermuda when they had access to millet part of the 24-hour period. Bites per minute were counted for three 1-minute periods for the tester cows on each of the 12 paddocks when cows were first turned in to graze after milking. All the cows on Bermuda paddocks grazed this grass to some extent but it became less attractive to them as the week progressed, Figures 16 and 17.

FIG. 20. These plots are typical of millet that was grazed rotationally in the experiment. Cows were rotated from the paddock at left and moved to one at right August 9, 1960. The millet was planted in late April.

Cows on Bermuda walked further between bites, thus reducing the number of bites per minute. Large numbers of Bermuda stolons were rejected by the cows and dropped on the surface of the grazed grass, Figure 18. Also shown in Figure 18 is a close-up of one of the closely grazed Coastal Bermuda paddocks. Figure 19 shows the new growth of millet forage available following grazing and mowing the stubble. Typical 1960 millet pastures are illustrated by Figure 20.

Pasture Clipping Management Study (1961)

In 1961 milk production level on millet was higher than on any Bermuda pasture, Figure 21. During the experiment the average monthly decline by cows on millet was less than 3 per cent. The monthly rates of decline ranged from 7 to 12 per cent on Bermuda, the most severe decline being by cows on that Bermuda pasture clipped at 8 inches. The rate of decline for Bermuda clipped at 4 inches each 3 weeks was slightly greater than for the similar treatment in 1960, Figure 14.

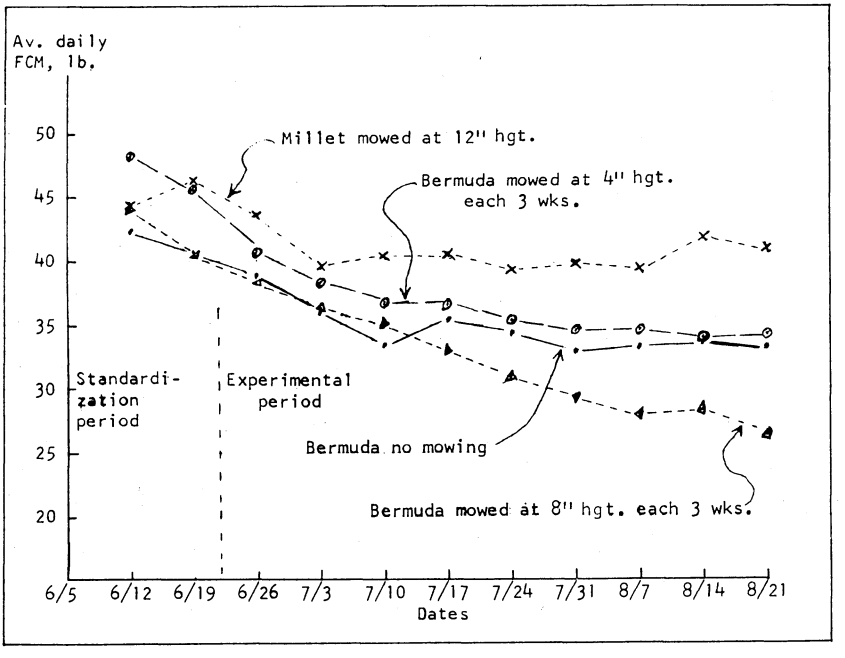

FIG. 21. Mean daily 4 per cent FCM by weeks per cow on Bermuda and millet under different clipping treatments, 1961. (Each point represents average of 6 cows.)

SUMMARY and CONCLUSIONS

Summer grazing studies were conducted on the Dairy Research Unit of Auburn University Agricultural Experiment Station each year from 1956 through 1961. The objective was to compare perennial summer grasses (Coastal Bermuda, Pensacola Bahia, and Dallis), Gahi-1 millet, and alfalfa hay for lactating dairy cows. Annual nitrogen rate was 200 to 250 pounds per acre put on in split applications at intervals of 3 to 6 weeks during the pasture season.

In these studies concentrates were fed at the rate of approximately 1 pound to each 4 pounds of 4 per cent fat-corrected milk.

Milk production from continuously grazing Coastal Bermuda, Bahia, and Dallis was unsatisfactory and persistency of lactation was below that normally expected. Irrigation increased the forage yield of Bermuda and Bahia during dry weather, but supplemental water did not improve forage quality or level of milk production.

Rotational grazing of Bermuda and Bahia was of little value in improving forage quality or milk production; however, a combination of intensive management practices — irrigation, clipping surplus forage, applying nitrogen, and rotational grazing at 3-week intervals — resulted in improved milk production by cows on Bermuda.

Gahi-1 millet when intensively managed was consistently the best forage for maintaining lactation at or above the normally expected rate of decline of 6 to 8 per cent per month. A combination of intensively managed Bermuda at night and millet during the day, or vice-versa, resulted in lactation performance nearly equal to that on millet alone.

The principle advantages of the intensive managements imposed were: (1) a more uniform, high-quality forage was produced throughout the season, and (2) there was a higher intake of forage by the cows.

No significant changes in bodyweight of the cows occurred during any of these studies.

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