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# Utilization of Alfalfa-Bromegrass as Soilage, Strip-Grazing, and Rotational Grazing for Dairy Cattle

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# Utilization of Alfalfa-Bromegrass as Soilage, Strip-Grazing, and Rotational Grazing for Dairy Cattle

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## INTRODUCTION

A continuing series of studies on forage utilization for dairy cattle summer feeding has been carried out at the Ohio Agricultural Research and Development Center. These studies have included a comparison of rotational and continuous grazing (2) and of soilage and silage (13). The study reported here is a comparison of soilage, daily strip-grazing, and rotational grazing for summer feeding of dairy cattle, using an alfalfa (*Medicago sativa* L.) and smooth bromegrass (*Bromus inermis* Leyss) mixture.

## REVIEW OF LITERATURE

Several recent reviews have covered the literature on summer feeding of dairy cattle (3, 15) and on experimentation in grazing management (16). No studies were found which closely parallel the Ohio study in treatments compared, species used, and stocking procedures followed.

Larsen (7) reported similar daily 4 percent fat-corrected milk (F.C.M.) per cow from rotational grazing, strip-grazing, soilage, and stored feeding of an alfalfa, ladino clover, and smooth bromegrass mixture with supplemental grain and, in one experiment, with supplemental hay as well. Rotational grazing resulted in markedly less milk per acre than the other treatments. In a later paper, Larsen and co-workers (8) reported similar milk production per cow from strip-grazing, soilage, and stored feed (hay and silage), using the same mixture as above. Soilage and strip-grazing resulted in 87 and 78 percent, respectively, of the production of 4 percent F.C.M. per acre of stored feeding.

Kennedy *et al* (4) compared three- and six-paddock rotational grazing, daily strip-grazing, and soilage of an alfalfa, ladino clover, and smooth bromegrass mixture, using a set-stocking procedure and harvesting excess growth to measure forage yield. In the first year, they obtained an average of about 6 lb. more milk per day from the six-paddock rotational grazing than from strip-grazing or three-paddock rotational

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grazing and 13 lb. more milk than from soilage. Feeding mature forage was partially the cause of reduced milk production of the soilage group. The two rotational grazing treatments averaged about 5 lb. more milk per day than strip-grazing and soilage the second year. They discuss the problem of stocking rate and its influence on animal production per acre.

In a later study (5), these workers report essentially the same total seasonal milk production per cow for all four treatments. With a set stocking procedure, production per acre was the same for the two rotational grazing and the strip-grazing treatments. Production per acre varied widely among the 3 years for the soilage treatment. Strip-grazing was the most favorable for the maintenance of alfalfa, with alfalfa stands declining steadily under the three-paddock system.

The importance of stocking rate on animal response has been shown by McMeekan and Walshe (9). Mott (12) has adequately discussed the problem of grazing pressure and the relative merits of using fixed and variable stocking rates.

## EXPERIMENTAL METHODS

Rotational grazing, daily strip-grazing, and soilage were compared as systems for summer feeding of dairy cattle at the Ohio Agricultural Research and Development Center, Wooster, in 1960, 1961, and 1962. The forage mixture was Vernal alfalfa-Lincoln smooth bromegrass, with alfalfa generally dominant, ranging from 50 to 75 percent of the mixture.

The soil types of the experimental area were Wooster and Canfield silt loam. The fields were kept in a 5-year rotation of corn, oats, and 3 years of meadow. Soil fertility was maintained at optimum levels with moderate applications of mixed fertilizer and liberal use of manure. The soil was maintained at pH 6.5-7.0 by periodic liming.

The registered Holstein-Friesians and Jerseys used in the study calved in February, March, and early April. Prior to the grazing season, the cows were held on a 14-day standardization period. The cows were then sorted into groups based on current and past milk production, stage of lactation, age, breed, and body weight. Animals were randomly assigned to the treatments from these groups. Three animals were designated as testers in each group of five to seven cows assigned to each treatment, with the others listed as grazers. When possible, all treatments had the same number of each breed.

A randomized complete block design was used, with two replications in 1960 and three replications in 1961 and 1962. The cows fed soilage received fresh-chopped forage twice daily in drylot. The amount of soilage fed to each group was weighed and sampled for determining percent moisture. The refusal was also weighed each day and sampled for moisture. Each treatment replication was fed soilage harvested from a different assigned field.

On the strip-grazed pastures, the areas available for grazing were limited by a movable electric fence. The lead wire was moved each morning to allow the cows an amount of fresh forage estimated to be sufficient for a day. The second wire was also moved, limiting the total area to a 3-day allotment to provide space for movement. The rotationally grazed fields were divided into six paddocks and the cows were rotated to a new paddock every 7-8 days.

To provide a 35-40 day forage recovery period for all fields, grazers were removed or added as seemed necessary. All cattle had access to lane areas where shade and water were provided.

To measure all of the forage in terms of animal product, the "put and take" procedure of Mott and Lucas (11) was used, rather than harvesting a portion of the growth as hay. To obtain maximum stocking of the pastures and as complete utilization of the forage as possible, together with a desirable level of animal performance, close daily observations were made by several researchers experienced in grazing and livestock feeding studies.

In 1960, a control group of animals was fed a uniformly high quality alfalfa hay and grain in the barn during the comparison period.

A light feed of concentrates was fed to all animals, with Holstein-Friesians getting 0.10 lb. for each pound of milk produced above 20 lb. and Jerseys getting 0.125 lb. for each pound of milk above 12 lb. This level of grain feeding resulted in the forage providing 83, 87 and 77 percent of the total digestible nutrient (TDN) requirements for 1960, 1961, and 1962. Feeding grain at this level does not result in substitution of grain dry matter for forage dry matter and does not change the relative milk production among treatments (13). A standard concentrate mixture of corn, oats, salt, and steamed bone meal, with 10.3 percent total protein, was used.

The comparison periods were from May 23 to September 10, 1960, May 13 to September 7, 1961, and May 10 to September 2, 1962, an average of 114 days. Because of drought in 1962, it was necessary to remove all animals from experiment from July 3-10 and from the soilage treatment only from August 4-20.

All animals were weighed when placed on experiment, upon removal, and at monthly intervals. Weighings were made for 3 successive days immediately following the morning milking and before being fed.

The calculated TDN consumed per acre was determined, using 7.93 lb. TDN per 1000 lb. body weight for maintenance and .324 lb. TDN per pound of 4% F.C.M. (10); and 3.53 and 2.73 lb. TDN for body weight gain and loss, respectively (6).

Dry matter digestibility and feed intake were periodically determined in 1960 and 1961, using the chromogen-chromic oxide technique (14) and chromic oxide impregnated paper (1).

## RESULTS AND DISCUSSION

### Animal Response

The method of utilizing the forage did not influence the average daily milk production (Table 1a). The opportunity for selective grazing did not result in higher daily milk production over soilage feeding, probably because of the close utilization of the grazed forage. The animals on the six-paddock rotational grazing treatment were kept on the pastures for several days after they indicated by their activity that they

**TABLE 1.—Milk Production per Cow per Day and per Acre from Forage and Grain, and Observed Cow-days per Acre from Four Forage Utilization Methods, 1960-62.†**

| | 1960 | 1961 | 1962 | 3-Yr. Av. | Relative Efficiency |
|---|---|---|---|---|---|
| (a) Pounds 4% F.C.M. per cow per day from forage and grain | | | | | |
| rotational grazing | 34.1 | 38.5 | 48.1 | 40.2 | |
| strip-grazing | 30.4 | 38.9 | 43.1 | 37.5 | |
| soilage | 29.4 | 39.6 | 46.5 | 38.5 | |
| stored feed (hay) | 35.4 | | | | |
| (b) Pounds 4% F.C.M. per acre from forage and grain | | | | | |
| rotational grazing | 4,428 | 5,702c** | 6,873 | 5,667b* | 100 |
| strip-grazing | 4,918 | 6,737b | 6,236 | 5,964b | 105 |
| soilage | 6,950 | 9,618a | 7,633 | 8,067a | 142 |
| stored feed (hay) | 8,210 | | | | |
| (c) Pounds 4% F.C.M. per acre from forage‡ | | | | | |
| rotational grazing | 3,670 | 4,988c** | 5,206 | 4,621b* | 100 |
| strip-grazing | 4,092 | 5,856b | 4,866 | 4,938b | 107 |
| soilage | 5,840 | 8,407a | 5,916 | 6,721a | 145 |
| stored feed (hay) | 6,666 | | | | |
| (d) Observed cow-days per acre from forage and grain | | | | | |
| rotational grazing | 130b* | 148b** | 142 | 140b* | 100 |
| strip-grazing | 162b | 175b | 144 | 160b | 114 |
| soilage | 235a | 242a | 164 | 214a | 153 |
| stored feed (hay) | 232a | | | | |

†Different letters within a column indicate significant differences ($*P<0.05$; $**P<0.01$), Duncan's multiple range test.

‡Percent TDN from forage X total 4% F.C.M.

wanted fresh pasture. As shown by Kennedy *et al* (4), animal behavior is not a good guide in deciding when a pasture has been adequately grazed. The strip-grazed cattle were limited to the amount of fresh pasture which they would effectively graze each day.

There were no statistically significant differences ($P>.05$) within years among the three green-forage utilization treatments. The increase in average daily milk production with each succeeding year reflects the use of higher-producing cows because of a larger group from which to select and higher initial production because of higher grain feeding prior to the comparison period. Differences between cows during the standardization period accounted for 66, 74, and 36 percent of the total variation in 1960, 1961, and 1962.

The increase in precision by using covariance was calculated. The relative precision of the adjusted values was 264, 364, and 149 percent, respectively, for the 3 years, showing the usefulness of this procedure. Although the covariance analysis reduced the residual error, it did not alter the non-significance of the treatment differences, compared with analysis of variance on the unadjusted data.

There was no statistical difference ($P>.05$) between breeds in pounds of 4% F.C.M. per cow per day—38.8 and 40.4 lb. per day for Jerseys and Holstein-Friesians, respectively. There also was no interaction between treatment and breed.

Utilizing the forage as soilage resulted consistently in more pounds of milk per acre than from either grazing system (Table 1b and 1c). The increase was statistically significant in 1961 ($P<.01$) and for the 3-year average ($P<.05$) Strip-grazing averaged slightly higher milk production than rotational grazing for the 3-year period and was significantly higher ($P<.01$) only for 1961. Soilage produced 45 percent more milk per acre over rotational grazing and 38 percent over daily strip-grazing.

Providing fresh pasture daily gave a small increase in milk production on the average over providing fresh grazing every 7-8 days. Some loss of forage by grazing compared with soilage would be expected because of trampling and contamination. Somewhat less loss would be expected from contamination of forage with urine and feces and trampling using daily strip-grazing compared with rotational grazing because of the shorter period the cattle are on a particular area. This is shown by the results obtained.

The number of observed cow-days per acre (Table 1d) reflects the greater utilization of forage as soilage than as grazing. The increase was statistically significant in 1961 ($P<.01$) and for the 3-year average ($P<.05$). Soilage resulted in 53 percent more observed cow-days than rotation grazing and strip-grazing 14 percent more, closely paralleling the percentages for pounds of milk per acre. The fewer observed cow-days in 1962 resulted from the severe drought late in the season, which reduced the carrying capacity of the forage and shortened the length of the season.

The acres of forage required per cow per season averaged 0.84, 0.74, and 0.55 acres for rotational grazing, strip-grazing, and soilage for the 3-year period. This 3-year period, 1960-62, was below average in rainfall, with 27.5, 36.0, and 27.9 inches, respectively, compared with the 75-year average of 37.6 inches.

The calculated TDN consumed per acre from forage (Table 2a) closely parallels the results for milk production per acre and observed cow-days per acre. The percent TDN from forage (Table 2b) and the average pounds of grain fed per cow per day (Table 2c) show the contribution of forage and grain to the total ration. The larger amount of grain fed in 1962 is reflected in the higher milk production of the

**TABLE 2.—Total Digestible Nutrients Consumed per Acre and Percent from Forage, Average Pounds of Grain Fed per Cow per Day, and Average Body Weight Changes from Four Forage Utilization Methods, 1960-62.**

| | 1960 | 1961 | 1962 | 3-Yr. Av. | Relative Efficiency |
|---|---|---|---|---|---|
| (a) TDN consumed per acre from forage | | | | | |
| rotational grazing | 2,364 | 2,852b** | 2,557 | 2,591b* | 100 |
| strip-grazing | 3,525 | 3,160b | 2,824 | 3,170b | 122 |
| soilage | 4,078 | 4,652a | 3,458 | 4,063a | 157 |
| stored feed (hay) | 3,672 | | | | |
| (b) Percent TDN of total ration from forage | | | | | |
| rotational grazing | 82.9 | 87.4 | 75.8 | | |
| strip-grazing | 83.3 | 86.9 | 78.1 | | |
| soilage | 83.9 | 87.4 | 77.8 | | |
| stored feed (hay) | 81.2 | | | | |
| (c) Average pounds of grain fed per cow per day | | | | | |
| rotational grazing | 4.7 | 3.6 | 7.5 | | |
| strip-grazing | 4 3 | 3.6 | 7.2 | | |
| soilage | 4.3 | 3.6 | 7.9 | | |
| stored feed (hay) | 5.2 | | | | |
| (d) Average body weight changes of tester animals | | | | | |
| rotational grazing | +82 | +17 | + 6 | +35 | |
| strip-grazing | +60 | +19 | +26 | +35 | |
| soilage | +67 | +38 | +55 | +53 | |
| stored feed (hay) | —33 | | | | |

†Different letters within a column indicate significant differences (*$P<0.05$; **$P<0.01$), Duncan's multiple range test.

cows. All animals increased slightly in body weight on all treatments (Table 2d), except the control group in 1960.

The control group fed hay and grain in the barn produced an insignificantly (P>.05) greater amount of milk per day than the green forage treatment groups (Table 1a). The control cattle consumed an average of 3,404 lb. of hay for the 110-day season and produced an average of 3,966 lb. of 4% F.C.M. per cow. If an average hay yield of 4.5 tons of hay per acre is assumed and a 20 percent loss from handling and storage, this would give a calculated 8,210 lb. of 4% F.C.M. per acre and 232 cow-days per acre (Tables 1b and 1d). Based on 5.0 tons and a 20 percent loss, the calculated 4% F.C.M. per acre would be 9,320 lb. and 258 cow-days from forage and grain.

The control group had about the same number of observed cow-days as the soilage group (Table 1d), while consuming slightly more grain (Table 2c) and losing some body weight. The net effect was 826 lb. more milk per acre (Table 1c) than from soilage, 2,574 lb. over strip-grazing, and 2,996 lb. over rotational grazing. The 14 percent increase from stored feeding over soilage agrees with the results of Larsen *et al* (8).

**Testers and Grazers**

An analysis of variance was also calculated, utilizing all animals, both testers and grazers. The daily milk production and daily weight changes of the grazers were weighted according to the periods during which they were used experimentally. The grazers were included in the analysis only for periods longer than 3 weeks and were fed similarily to the tester animals when not on experiment. Again there were no significant differences in daily milk production—39.1, 37.4, and 37.9 lb. for rotational grazing, daily strip-grazing, and soilage, respectively. Increasing the animal numbers by including the grazers resulted in increasing the coefficient of variability from 13.7 with testers only to 22.1 with all cattle included in the analysis.

There were no significant differences (P>.05) in body weight changes of the cattle on the three green-forage treatments. Again no effect of breed and no treatment X breed interaction was found. Adjusting for body weight differences by covariance in addition to the standardization period adjustment did not further reduce treatment variability.

**Carrying Capacity**

The seasonal trends in carrying capacity are shown in Figure 1. The values shown are the observed cow-days by weekly periods and are the 3-year averages. The soilage treatment carried consistently more

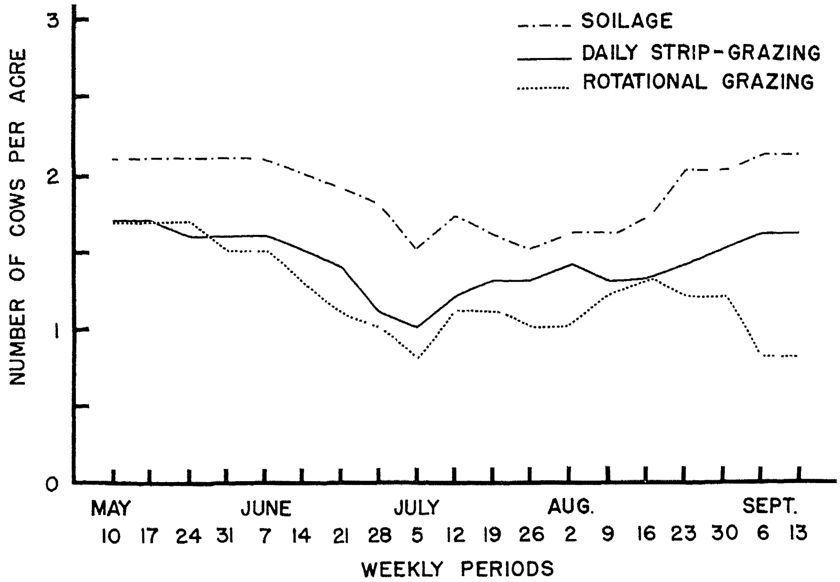


**Fig. 1—Number of observed cow-days per acre with three forage utilization methods, 1960-62 averages.**

animals per acre throughout the season than either grazing method. After the first several weeks, the strip-grazing treatment carried more animals per unit area than rotational grazing. All treatments showed the seasonal changes in forage production.

**Persistency of Milk Production**

The relative persistency of milk production determined as the mean daily 4% F.C.M. production during the comparison period as a percent of the standardization period was generally similar within years (Table 3). However, in 1960 the soilage-fed cattle were lower in relative persistency than the other three treatments. In 1962, the cattle on rotational grazing averaged higher in relative persistency than the other treatments. The 3-year averages for the three treatments were similar.

The regression coefficients (Table 3) show the daily decline in milk production as a percent of the standardization period. The values for 1960 and 1961 show a much lower rate of decline for soilage than for the other treatments, not statistically significant ($P>.05$) in 1960 and significantly lower ($P<.05$) than the daily strip-grazing treatment in 1961. Conversely, in 1962 the regression value for the soilage treatment is higher than for the other two treatments but the values are not statistically different ($P>.05$).

TABLE 3.—Standardization Period Daily 4% F.C.M., Relative Persistency of Milk Production (Mean Daily 4% F.C.M.), and Daily Decline† in Production of 4% F.C.M. during Comparison Period as a Percent of Standardization Period.

| | 1960 | | | 1961 | | |
|---|---|---|---|---|---|---|
| | Standardization Period Daily 4% F.C.M. | Mean Daily Production as % of Standardization Period | Daily Decline‡ | Standardization Period Daily 4% F.C.M. | Mean Daily Production as % of Standardization Period | Daily Decline |
| | lb. | % | b | lb. | % | b |
| Rotational grazing | 43.3 | .76 | .24 a | 47.1 | .84 | .47 ab |
| Daily strip-grazing | 42.8 | .76 | .34 a | 46.7 | .88 | .53 a |
| Soilage | 49.1 | .67 | .15 a | 44.6 | .86 | .39 b |
| Stored feed (hay) | 46.6 | .75 | .30 a | | | |

| | 1962 | | | 3-Year Av. | |
|---|---|---|---|---|---|
| | Standardization Period Daily 4% F.C.M. | Mean Daily Production as % of Standardization Period | Daily Decline‡ | Standardization Period Daily 4% F.C.M. | Mean Daily Production as % of Standardization Period |
| | lb. | % | b | lb. | % |
| Rotational grazing | 60 2 | .87 | .28 a | 50.2 | .82 |
| Daily strip-grazing | 60.6 | .74 | .29 a | 50.0 | .79 |
| Soilage | 62.0 | .77 | .43 a | 51.9 | .77 |
| Stored feed (hay) | | | | | |

†Daily decline computed as regression coefficient of percent production on day.
‡Regression values followed by same letter are not statistically different (P>.05).

The changes in milk production during the comparison periods are plotted by weekly averages in Figure 2. In 1960, all treatments had declined markedly from the standardization period level. The start of the summer-feeding comparison was delayed to allow development of the new forage stands being used, accounting for the decline. All cattle on green-forage treatments increased temporarily in milk production when placed on treatments, compared with the continued decline of the control-group.

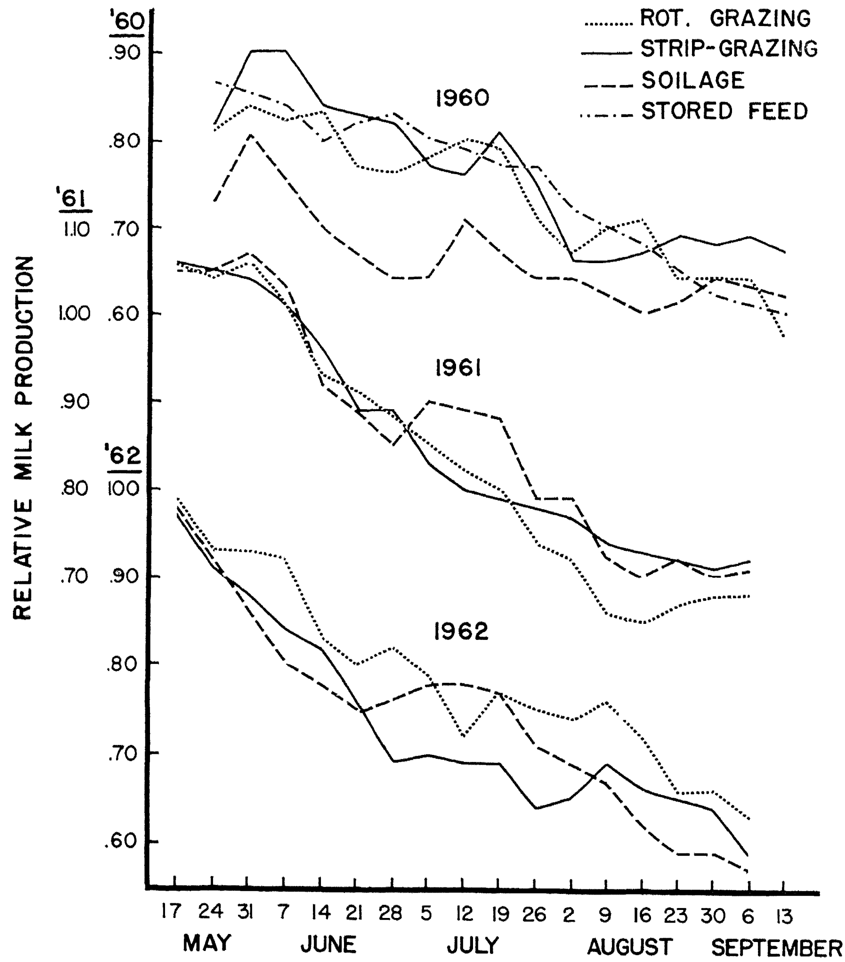


**Fig. 2.—Relative milk production during the comparison period (mean weekly 4% F.C.M. production during comparison period as a percent of the standardization period).**

The apparent discrepancy between the lower relative persistency for soilage treatment in 1960 and the lower daily decline in milk production (shown in Table 3) can be explained as follows. Figure 2 shows that in 1960 the soilage groups had declined to a much lower relative level in milk production at the beginning of the comparison period than the other treatment groups, but then declined less rapidly than the other groups. The soilage groups ended the season at about the same relative level of milk production as the other groups except for the strip-grazing treatment.

In 1961 and 1962, the three treatments generally appear to be parallel to each other in relative decline in milk production (Figure 2), verifying the data in Table 3. The slightly higher relative persistency of the rotational grazing treatment in 1962 is seen in the higher production during the entire season except from about July 5 to 19. The fluctuations in relative milk production in Figure 2 largely reflect the decline in forage maturity, as well as changes to fresh pasture in the case of rotational grazing or changes to second, third, or fourth growth in the case of soilage-fed animals.

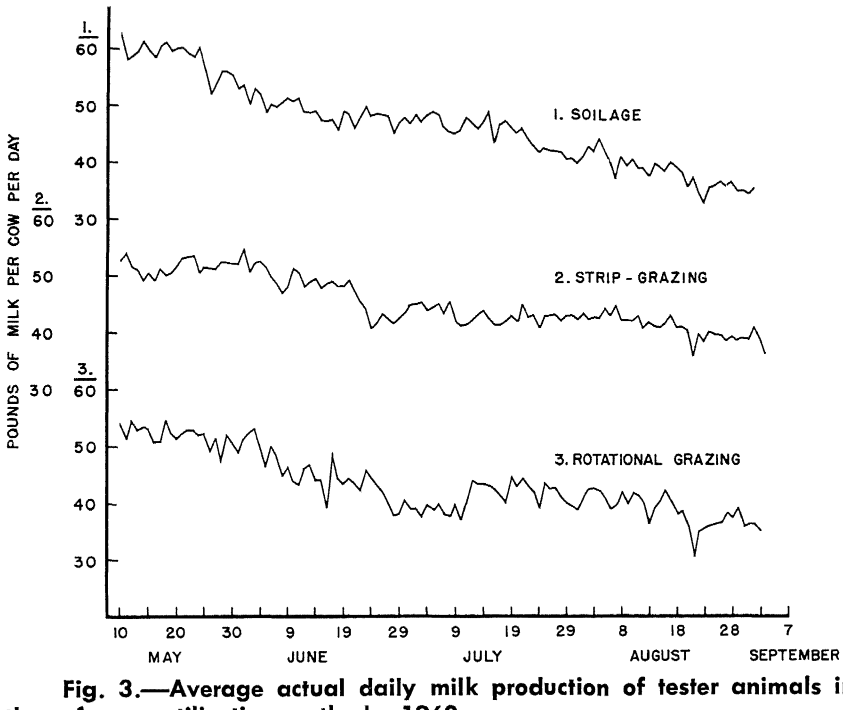


**Fig. 3.—Average actual daily milk production of tester animals in three forage utilization methods, 1962.**

The barn-fed control group in 1960 was less subject to fluctuations, reflecting the uniformity of the forage fed, compared with the constant changes occurring in the growing forage consumed by the other groups. In 1961 there was an initial increase in relative milk production above the standardization period production when the cattle were placed on the forage treatments.

To show more clearly the amount of fluctuation in milk production among treatments, the actual average daily milk production of the tester animals for the first replication of each treatment for 1962 are plotted in Figure 3. Greater fluctuation occurred with rotational grazing treatment compared with daily strip-grazing and least with soilage. Each short-time increase in milk production on rotational grazing generally coincides with a change to a fresh paddock, with a subsequent decline in productivity as the animals selectively graze. Small fluctuations can be seen with the soilage, as well as general declines with the first, second, and third growth, particularly noticeable during the first period (May 10 - June 20).

In general, it appears that there was no treatment effect on relative persistency of milk production, despite some wide fluctuations in milk production resulting from changes in the forage consumed. The differences noted in Table 3 apparently reflect animal variation rather than forage treatment effects. Kennedy *et al* (5) also showed variation in relative persistency of milk production among four green-forage utilization systems but almost identical 4-year averages for the treatments.

**Forage Dry Matter Digestibility and Intake**

The forage dry matter digestibility of grazed forage was consistently higher than that of soilage (Figure 4). The May, July, and August values are for the early stage of the first, second and third growth and indicate the excellent quality of the forage at these dates. The values for June 13 and 20 in 1960 and for June 5 and 19 in 1961 show the decline in dry matter digestibility of the soilage with advancing maturity, dropping to 55 and 60 percent for 1960 and 1961.

The values for soilage are for the entire harvested plant in contrast with the higher values for the grazed forage, where selectivity by the grazing animals is reflected. Although the soilage declined sharply in digestibility during mid-June until the second growth could be fed, the period is relatively brief and did not result in much more rapid decline in milk production during that period compared with grazing except in 1960 (Figure 2).

The rapid changes in dry matter digestibility indicate the need for flexibility in a soilage feeding program. One must be prepared to switch to the regrowth and to utilize the surplus forage as hay or silage before it becomes too mature, rather than continuing to feed rapidly maturing material and sacrifice milk production.

In general, the forage dry matter intake and total dry matter intake were similar among treatments for individual digestion trial dates (Table 4), with several exceptions. The average digestible dry matter intakes per 1000 lb. of liveweight were almost identical within years for the three treatments: 21.9, 21.2, and 21.1 for rotational grazing, daily strip-grazing, and soilage in 1960 and 27.2, 28.9, and 27.3 in 1961. The average daily dry matter consumption of soilage per cow, as determined by daily weighings of forage fed and forage refusal, was 26, 26, and 28 lb. for 1960, 1961, and 1962, with a range of 22 to 33 lb.

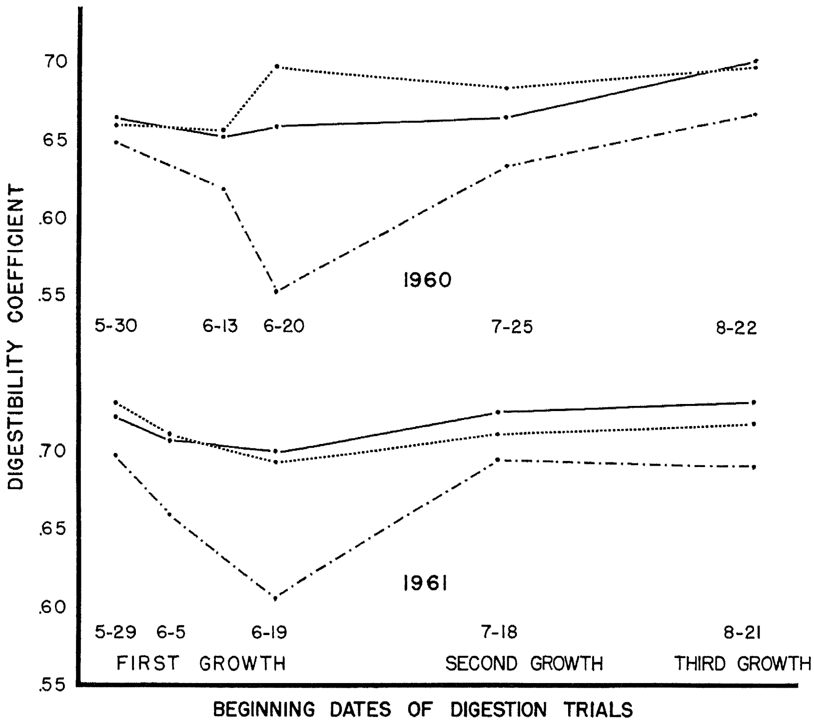


**Fig. 4.—Forage dry matter digestibility of alfalfa-smooth bromegrass consumed by dairy cattle on three forage utilization methods, 1960-61, as determined by the chromogen-chromic oxide technique.**

**TABLE 4.—Forage Dry Matter Digestibility, Forage Dry Matter Intake, and Total Dry Matter Intake of Dairy Cattle on Three Forage Utilization Methods, 1960-61.**

| | 1960 | | | | | |
|---|---|---|---|---|---|---|
| | First Growth | | | Second Growth | Third Growth | |
| **Treatment** | **5/30†** | **6/13** | **6/20** | **7/25** | **8/22** | **Av.** |
| Rotational grazing | | | | | | |
| digestibility coefficient of forage dry matter | 65.9‡ | 65.6 | 69.7 | 68.4 | 69.8 | 67.9 |
| forage dry matter intake per 1000 lb. | 24.2 | 29.9 | 26.4 | 32.0 | 29.0 | 28.3 |
| total dry matter intake per 1000 lb. | 28.7 | 33.5 | 31.2 | 36.6 | 31.1 | 32.2 |
| average digestible dry matter intake per 1000 lb. | | | | | | 21.9 |
| Strip-grazing | | | | | | |
| digestibility coefficient of forage dry matter | 66.4 | 65.2 | 65.9 | 66.6 | 70.1 | 66.8 |
| forage dry matter intake per 1000 lb. | 20.8 | 30.2 | 27.0 | 29.3 | 28.4 | 27.1 |
| total dry matter intake per 1000 lb. | 26.0 | 34.6 | 32.1 | 34.7 | 31.7 | 31.8 |
| average digestible dry matter intake per 1000 lb. | | | | | | 21.2 |
| Soilage | | | | | | |
| digestibility coefficient of forage dry matter | 64.8 | 61.8 | 55.1 | 63.4 | 66.8 | 62.4 |
| forage dry matter intake per 1000 lb. | 29.2 | 27.5 | 29.1 | 35.1 | 27.0 | 29.6 |
| total dry matter intake per 1000 lb. | 34.1 | 31.8 | 33.9 | 39.2 | 29.8 | 33.8 |
| average digestible dry matter intake per 1000 lb. | | | | | | 21.1 |

†Date digestion trial was started.
‡Average of two animals in 1960, three animals in 1961.

TABLE 4. (Continued)—Forage Dry Matter Digestibility, Forage Dry Matter Intake, and Total Dry Matter Intake of Dairy Cattle on Three Forage Utilization Methods, 1960-61.

| | 1961 | | | | | |
|---|---|---|---|---|---|---|
| | First Growth | | | Second Growth | Third Growth | |
| Treatment | 5/29 | 6/5 | 6/19 | 7/18 | 8/21 | Av. |
| Rotational grazing | | | | | | |
| digestibility coefficient of forage dry matter | 73.0 | 71.0 | 69.2 | 71.0 | 71.7 | 71.2 |
| forage dry matter intake per 1000 lb. | 31.2 | 40.4 | 35.7 | 26.7 | 40 2 | 34.8 |
| total dry matter intake per 1000 lb. | 34.5 | 43.8 | 39.3 | 30.0 | 43.3 | 38.2 |
| average digestible dry matter intake per 1000 lb. | | | | | | 27.2 |
| Strip-grazing | | | | | | |
| digestibility coefficient of forage dry matter | 72.1 | 70.6 | 69.9 | 72.4 | 73.1 | 71.6 |
| forage dry matter intake per 1000 lb. | 30.5 | 41.8 | 43.4 | 34.0 | 37.4 | 37.4 |
| total dry matter intake per 1000 lb. | 33.5 | 45.0 | 46.6 | 37 1 | 40 0 | 40.4 |
| average digestible dry matter intake per 1000 lb. | | | | | | 28.9 |
| Soilage | | | | | | |
| digestibility coefficient of forage dry matter | 69.7 | 65.8 | 60.4 | 69.4 | 69.0 | 66.9 |
| forage dry matter intake per 1000 lb. | 34.8 | 39.8 | 40.7 | 33.4 | 39.5 | 37.6 |
| total dry matter intake per 1000 lb | 38.0 | 43.3 | 44.0 | 36.0 | 42.6 | 40.8 |
| average digestible dry matter intake per 1000 lb. | | | | | | 27.3 |

**TABLE 5.—Dry Matter Yield of Alfalfa-Smooth Bromegrass Soilage Harvested per Acre by 2-Week Periods and Total Yield, 1960-62.**

| Period | 1960 | 1961 | 1962 | 3-Year Av. |
|---|---|---|---|---|
| | | Pounds | | |
| 5/10-5/24 | 95* | 759‡ | 960 | 604 |
| 5/25-6/7 | 711 | 925 | 1035 | 890 |
| 6/8-6/21 | 803 | 1251 | 948 | 1001 |
| 6/22-7/5 | 738 | 1072 | 366†† | 725 |
| 7/6-7/19 | 727 | 702 | 470 | 633 |
| 7/20-8/2 | 917 | 483 | 566 | 655 |
| 8/3-8/16 | 961 | 584 | 265‡‡ | 603 |
| 8/17-8/30 | 962 | 839 | 586 | 796 |
| 8/31-9/9 | 624† | 494** | 74*** | 397 |
| Season Total | 6,536 | 7,109 | 5,270 | 6,305 |

*2 days harvest
†10 days harvest
‡12 days harvest
**7 days harvest
††11 days harvest
‡‡5 days harvest
***1 day harvest

**Forage Yield and Stand Persistence**

The fields used for soilage averaged 3.27, 3.55, and 2.64 tons of dry matter per acre in 1960, 1961, and 1962 (Table 5). Severe drought conditions in 1962 reduced the yield for that year. Generally three cuttings were made, with a portion of the fields receiving four cuttings. The percent dry matter of the soilage averaged 23.3 percent, with a range from 14.5 to 37.5 percent. The latter value was reached only during the drought period of 1962.

The forage chopped during the drought period was markedly higher in dry matter than during normal growing conditions. The soilage chopped in 1962 averaged 26.0 percent dry matter compared with 21.1 for 1960 and 1961. The forage chopped in the afternoon averaged about 4 percentage points higher in dry matter than the material chopped in the morning.

There were no observable differences in stands of alfalfa-smooth bromegrass between the fields used for the three treatments. All fields maintained good stands of alfalfa after 3 years of production under each treatment. The 3 years of the study were drier than normal, particularly 1960 and 1962, and this would be favorable for longevity of alfalfa.

## SUMMARY

Dairy cattle fed a light feed of grain had similar average daily milk production on alfalfa-smooth bromegrass utilized as rotationally grazed pasture, daily strip-grazed pasture, or soilage. Utilizing the forage as soilage resulted in about 40 percent more milk per acre than from either grazing system. A control group barn-fed good quality alfalfa hay and a light feed of grain during the first year of the study had average daily milk production similar to the green-forage fed group but produced the most milk per acre.

Forage utilized as soilage carried consistently more animals per acre throughout the season than either grazing system. After the first several weeks, strip-grazing carried more animals per unit area than rotational grazing.

Fluctuations in milk production resulted from maturity changes in the forage consumed. In general, however, it did not result in differences in relative persistency.

The forage dry matter digestibility of grazed forage was consistently higher than that of soilage. A marked decline in dry matter digestibility of soilage was shown in mid-June, which contrasted with the continued high level of digestibility of the grazed forage.

All fields maintained good stands of alfalfa during the 3 years of production under each treatment, with the alfalfa dominating the smooth bromegrass under the harvesting practices followed.

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