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Effect of Hay or Rate of Grain Supplementation on Performance of Lactating Dairy Cows Fed Clipped Pasture Forage

Clive Wendell Arave
Utah State University

EFFECT OF HAY OR RATE OF GRAIN SUPPLEMENTATION ON PERFORMANCE OF LACTATING DAIRY COWS FED CLIPPED PASTURE FORAGE

by

Clive Wendell Arave

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Clive W. Arave

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INTRODUCTION

Pasture is considered one of our most important agricultural crops, contributing more than one third of all feed consumed by livestock in the United States. High quality pasture has been recognized to be highly important in efficient milk production. It has been shown, however, that good pasture must be supplemented by concentrates if milk production is to be maintained at a high level.

A pasture mixture developed at the Utah Agriculture Experiment Station has yielded considerably more total digestible nutrients per acre than other roughages or farm grains commonly grown in Utah. Concentrates tend to be relatively more expensive than roughages. If part of the concentrates generally recommended for milk production could be replaced by high yielding pasture or good quality alfalfa hay without loss of production it would be economically advantageous to the dairy farmer.

As the amount of grain fed is reduced, it appears likely that cows on pasture will consume more pasture forage or milk production and body weight will be affected adversely. The purpose of this experiment is to determine the effects on pasture consumption, persistency of milk production and body weight changes of feeding hay or various amounts of grain to lactating cows fed clipped pasture forage.

REVIEW OF LITERATURE

Kopland, et al. (1954) noted that the average 1200 pound cow consumed about 100 to 150 pounds of fresh grass daily. A 1600 pound cow producing 4 to 5 gallons of milk daily consumed 160 to 200 pounds of grass. It was observed that one cow consumed 218 pounds of clipped grass in one day when receiving no supplemental feed. Graves, et al. (1933) reported that dairy cattle weighing between 1200 and 1600 pounds and producing 20 to 25 pounds of 4 percent fat-corrected-milk (FCM) per day consumed 35 to 40 pounds of clipped pasture dry matter daily. Johnston-Wallace and Kennedy (1944) reported that beef cows on pasture consumed 20 to 25 pounds of pasture dry matter per 1,000 pounds of body weight daily. Woodward (1936) stated that the limit of a cow's capacity was about 150 pounds of green weight or 30 to 35 pounds of dry matter. Ewalt and Morse (1942) reported similar findings. They also stated that 100 pounds of pasture contained 3.1 pounds of digestible protein and 15.2 pounds of total digestible nutrients. This quantity of pasture is sufficient to maintain a 1,000 pound cow and enable her to produce 18 pounds of 5 percent milk daily. Kopland, et al. (1954) concluded that cows grazing "good" pasture should produce 30 pounds of FCM. For each additional 5 pounds of milk produced daily, 2.2 pounds of grain would be needed. "Average" pasture was sufficient for cows to produce only half this amount of milk.

Feeding trials at the Utah Station (Stoddard, et al. 1954) (Stoddard, et al. 1955) indicated that cows grazing high yielding irrigated pastures maintained milk production at a high level even when the

amount of grain was reduced. Twenty-four lactating Holsteins were assigned to 3 treatment groups designated as high, medium and low. The high group received 1 pound of grain for each 5 pounds of milk, the medium group received 1 pound of grain for each 10 pounds of milk and the low group received only 1 pound of grain daily in addition to pasture. A close rotational system of grazing was followed during both trials. In 1953 FCM production for 153 days was 5,682, 5,861 and 5,624 pounds for the low, medium and high groups respectively. Production of FCM in the 1954 trial was 4,297, 4,901 and 4,991 pounds for the 3 groups respectively.

Hazlewood (1936) noted that the production of butterfat for a "no-grain" group of cows was 92 percent of the amount produced by cows fed grain at the grain:milk ratio of 1:3. Both groups received pasture, silage, and alfalfa hay. The trial represented a total of 33 lactations extending over a 5 year period. It was observed that the average physical condition of the 2 groups was the same.

Cole, et al. (1957) divided a group of 9 Holstein and 9 Jersey cows into 3 comparable groups. All 3 groups received pasture plus grain according to Morrison's standards. One group was fed alfalfa in addition to pasture and grain while another group was fed supplemental alfalfa silage. The trial lasted 16 weeks. There was no significant increase in dry matter consumption when supplements were fed. However, the hay group consumed 33.9 percent less pasture dry matter and those fed silage consumed 13.1 percent less pasture dry matter than the group fed no supplemental roughage. There was no significant difference in milk production or in body weight change between the 3 groups.

In 2 Iowa trials (Autrey, et al. 1942) cows were fed alfalfa hay

and corn silage. One group of 5 cows received grain at a grain:milk ratio of 1:8, another group was fed at a grain:milk ratio of 1:4 and a third group was fed roughage only. In a double reversal trial cows on the high roughage ration produced 604.1 pounds of butterfat, cows on the medium roughage produced 568.9 pounds butterfat and those on the low roughage produced 537.6 pounds butterfat. During the second trial 18 cows produced an average of 29.0 pounds FCM per day on high roughage, 30.1 pounds on medium roughage and 32.8 pounds on low roughage. During both trials cows lost weight on the high-roughage diet. Dry matter consumption was highest on the low-roughage ration. Limited grain feeding (medium roughage) proved to be the most economical.

Dickson and Kopland (1934) at the Montana Station reported that 10 cows on roughage alone averaged 464 pounds butterfat in 365 days. Ten cows on a limited grain:milk ratio of 1:6 produced 22 percent more butterfat than cows on roughage alone but produced 94 percent as much as a 10 cow group receiving twice as much grain. According to the average production of the cows in each group it would require 100 acres to raise feed for 21 cows fed grain at the grain: milk ratio of 1:3, 78 acres if fed grain at the ratio of 1:6 and 54 acres if fed alfalfa only. Full grain feeding "proved wasteful and decidedly uneconomical".

The average production for 36 lactations of 15 cows fed a limited grain ration was 9,277 pounds of FCM on a mature equivalent basis (Pratt 1955). Seventeen cows on a liberal grain ration in 41 lactations averaged 8,765 pounds of FCM. Cows on a liberal grain ration declined in production consistently from lactation to lactation. Cows on the limited grain ration started at a lower level of production but equalled the liberal grain group at the second lactation and increased in the third and fourth lactations. "It is apparent that this group had to consume

more hay and pasture to compensate for greater production and weight gain."

Lindsey and Archibald (1932) reported that cows on a low roughage (grain:milk ratio of 1:2½) diet required 7 percent less dry matter and 2.7 percent less digestible nutrients per 100 pounds milk produced than cows on a high roughage (grain:milk ratio of 1:4½) diet. They concluded that "In order to keep cows looking well and producing somewhere near the limit of their ability, reasonably liberal grain feeding must be practiced."

Graves (1938) fed 15 cows on alfalfa alone. Their average mature equivalent production for 24 lactations was 11,125 pounds milk and 389.6 pounds butterfat. This was about 58 percent of the production of a comparable group fed grain at the ratio of 1:3.

Martin, et al. (1954) fed hay at various rates and added enough concentrates to supply total digestible nutrients at 100 percent of Morrison's recommended level. The 4 levels of hay fed were 0.50, 1.17, 1.83, and 2.50 pounds per 100 pounds bodyweight. It was noted that when total digestible nutrients and estimated net energy were held constant there was no significant difference in milk production as affected by the level of hay fed. However, protein and dry matter digestibility declined as hay content increased.

Loosli, et al. (1955) stated that more accurate methods are needed for computing the usefulness of feeds for lactation. In a reversal type experiment with 25 cows it was observed that cows produced 2.5 pounds more FCM per head daily when 6.8 pounds of concentrates replaced 10.2 pounds of hay containing equal amounts of total digestible nutrients but more estimated net energy.

Heath and Miller (1947) reported no significant difference in milk production when pasture hay was fed free choice or in limited amounts

to cows while on pasture. Cows fed hay free choice consumed an average of 5.54 pounds of hay per day while the limited hay group consumed an average of 4.69 pounds per day. In addition to hay the cows were fed 0.4 pounds of grain per pound of milk above 13 pounds per day. Seath, et al. (1956) divided a group of 8 Holstein and 8 Jersey cows into 2 groups. In addition to pasture both groups received a 11 percent protein grain ration according to Morrison's recommended level. One group was fed all the alfalfa hay they would eat in addition to pasture. Dry matter intake was measured by the fecal chromogen and chromic oxide technique. The average dry matter intake of hay was 8.2 pounds per day and the average total dry matter intake for the group was 29.6 pounds. The dry matter intake of the no-hay group was 26.6 pounds, the difference being significant at the 5 percent level. There was no significant difference in milk production between the two groups, however, the hay group averaged 50 pounds body weight gain higher than the no-hay group. Ewalt and Morse (1942) stated, "When pastures are lush, hay should not be fed because pasture is the cheapest and should be used to the full extent. Additional roughage fed with pasture should be limited to encourage maximum grazing."

Huffman (1939) in a comprehensive review on roughage quality and quantity in the dairy ration indicated that the high milk production reported on roughage alone may have been due to the liberal feeding of grain during previous lactations. He concluded that the variable results obtained from feeding alfalfa alone would indicate grain should supplement roughage.

Reid (1956), in summarizing literature, stated that cows fed on all-roughage rations not deficient in essential nutrients generally produce only 70 to 87 percent as much milk as they theoretically would if

they were fed concentrates at the rate of 1 pound of grain for each 6 pounds of milk. When the hay equivalent intake dropped below 0.4 pounds per 100 pounds of body weight per day and the concentrate content of the ration neared 100 percent, milk yield was reduced, fat content decreased and physiological disturbances of the cows were noted.

Morrison (1949) stated, "The needs of good cows for total digestible nutrients and net energy cannot be fully met by supplying only an abundance of roughage, without the feeding of any grains or other concentrates."

Woodward (1936) stated, "It appears that if a cow will eat enough immature grass to provide the required digestible nutrients and if this grass has a normal content of minerals, her ration is not likely to be deficient in any of the essential food constituents."

METHOD OF PROCEDURE

Animals and treatments

Sixteen lactating Holstein cows were selected for uniformity of age, stage of lactation, and level of production. Cows were assigned at random to 4 treatment groups of 4 cows each. The treatment groups were designated as follows: The C-grain group received clipped pasture forage only. In addition to pasture the 1:10 group received 1 pound of grain for each 10 pounds of milk produced, the 1:5 group received 1 pound of grain for each 5 pounds of milk produced and the hay group received 10 pounds of alfalfa hay per cow daily.

The cows were kept in dry lot and tied to individual covered manger spaces for feeding. Forage was clipped each morning and weighed to individual cows as needed during 3 daily feeding periods of about 3 hours each. Feed not eaten (orts) was weighed back daily and the dry matter of the orts was subtracted from the dry matter of the forage fed. Grain was fed after each milking. Alfalfa hay was fed during the evening feeding period. Water, steamed bone meal and salt were available at all times except when cows were tied to the mangers for feeding.

Cows were milked twice daily and milk weights were recorded for each milking. Cows were weighed twice each month.

Pasture forage

A sufficient acreage of pasture was reserved to provide the cows with all the grass they would consume. All pastures except pasture D were of the high-yielding mixture (Bateman and Keller, 1956) consisting

of ladino clover, ranger alfalfa, red clover, smoth bromegrass, orchard grass and tall oatgrass. Pasture D, which was clipped only once during this experiment, contained 32 experimental mixtures in separate plots.

Pasture for this experiment was clipped or grazed until forage became so mature that it was relatively unpalatable. Pastures were then grazed by the main herd except for pasture E which was harvested for hay. Recovery time between grazings or clippings ranged from 3 to 6 weeks.

Pastures were clipped daily by either tractor or horse-drawn mowing machine with attached windrow curlers. Forage was not chopped but was taken directly from the windrow to the cows. Most of the clipped forage was weighed to individual cows in the morning soon after clipping. The remaining forage was placed in the shade under burlap which was sprinkled with water periodically to keep the forage fresh. Wet burlap was hung along the outer edge of the manger in front of the cows to help minimize evaporation.

The clipped area was measured each day. Two 2-pound samples were plucked at random from the clipped windrow twice weekly for dry matter determination and for chemical analysis.

Grain mixture

The grain mixture was composed of 3 parts barley, 2 parts wheat and 1 part dried molasses beet pulp. One percent salt and steamed bone meal were added to the grain mix. In addition, salt and steamed bone meal was available free choice.

Chemical analysis

Samples for dry matter determinations were weighed into cloth sacks and placed in a heated drying cabinet. Samples were allowed to dry for at least 48 hours after which time they were removed from the drier and

cooled. Samples were then weighed, ground in a Wiley mill and sealed in glass jars.

Air dry matter was based on moisture loss in the drying cabinet. Oven dry weight was determined on the ground sample at the time of chemical analysis. Dry matter recorded is on the air dry basis.

Nitrogen was determined by the Kjeldahl method as outlined in the Association of Agricultural Chemists; Methods of Analysis (A.O.A.C.) (1955). The percent nitrogen was multiplied by 6.25 to obtain the crude protein value. Crude fiber, ether extract, phosphorus and ash were also determined by methods of A.O.A.C.. Total digestible nutrients were determined using the methods outlined by Morrison (1949) and calculated on the air dry basis. The coefficients of digestibility used were listed under the following: for pasture, "pasture grasses and legumes, mixed from well-grazed, fertile pasture, northern states."; for barley, "common, not including Pacific coast states"; for wheat, "average of all types"; for alfalfa hay "all analysis". Dried molasses beet pulp was listed as such.

Statistical analysis

Analysis of variance methods for single variables were used to compare treatment groups for each of the following: pasture dry matter consumed, total dry matter consumed, total digestible nutrients consumed, gain in body weight, milk produced, FCM produced, and persistency of milk production.

Length of Experiment

This experiment commenced May 22, 1956, and was concluded September 20, 1956, a period of 122 days.

RESULTS AND DISCUSSION

Feed consumption

Data in table 1 indicate that the 0-grain group consumed more pasture than any other group. Their average daily consumption of pasture dry matter was 31.5 pounds. There was virtually no difference in pasture consumption between the 2 groups receiving grain. The 1:10 group consumed 29.5 pounds of pasture dry matter while the 1:5 group's consumption was 29.7 pounds. The hay group with a consumption of 27.7 pounds daily was 12 percent below the 0-grain group's consumption of pasture. Total average pasture dry matter consumed per cow was 3841, 3596, 3623 and 3383 pounds for the 0-grain, 1:10, 1:5 and hay groups respectively.

Seasonal trends in pasture dry matter consumption are shown in figure 1. The 0-grain group, except for a 3 week period, was consistently higher than the other groups in pasture consumption while the hay group's consumption of pasture was consistently the lowest. Statistical analysis of the data indicated that the differences were not significant (P .05). Supplemental feeding evidently had little affect on pasture consumption.

Supplemental feeding influenced total dry matter consumption as in shown in figure 2. The 1:5 group consistently consumed more total dry matter than any other group. The consumption curves for the 1:5, hay and 0-grain groups ran uniformly parallel courses throughout the season. The 1:10 group's consumption declined to the level of the 0-grain group during the tenth week, after which time the 2 groups followed the same general trend. Total dry matter consumption (table 1)

Table 2. Feed consumption, body weight change and milk production of lactating cows fed clipped pasture forage or clipped pasture forage with hay or various levels of grain for a 122 day period (1956).

	Average per cow			
Number of cows	4	4	4	4
Level of supplementation	0-grain	1:10	1:5	10# hay
Total grain consumed (lbs.)	0	420.0	1,010	0
Total hay consumed (lbs.)	0	0	0	1,105.9
Total pasture consumed (lbs.)				
Green wt.	16,470	15,386	15,504	14,483
D.M.	3,841	3,596	3,623	3,383
Total D.M. consumed (lbs.)	3,841	3,965	4,510	4,365
T.D.N. consumed (lbs.)	2,304	2,428	2,823	2,513
Initial body wt. (lbs.)	1,217	1,120	1,317	1,257
Gain in wt. (lbs.)	94	104	92	53
Production:				
Milk (lbs.)	4,161	3,890	4,750	4,488
~~Butterfat~~ (lbs.)	148	142	158	157
FCM (lbs.)	3,881	3,689	4,274	4,144
Comparative level of 10 day prior milk production (% of 1:5)	106.8	82.6	100.0	95.8
FCM adjusted to prior production (lbs.)	3,661	4,465	4,274	4,323
Ave. production during trial as % of prior production	64.0	77.3	78.0	76.9
Pounds FCM per lb. D.M. consumed.	1.010	.930	.948	.949
Pounds FCM per lb. T.D.N. consumed	1.684	1.519	1.514	1.649

w/Hay = $25/T
Pasture = $25/T of DM
grain = $3 cwt
FCM = $4 cwt

Feed cost	48.01	57.55	75.59	56.12
FCM milk value	155.24	147.56	171.06	164.56
return over feed cost	107.23	90.01	95.47	108.44

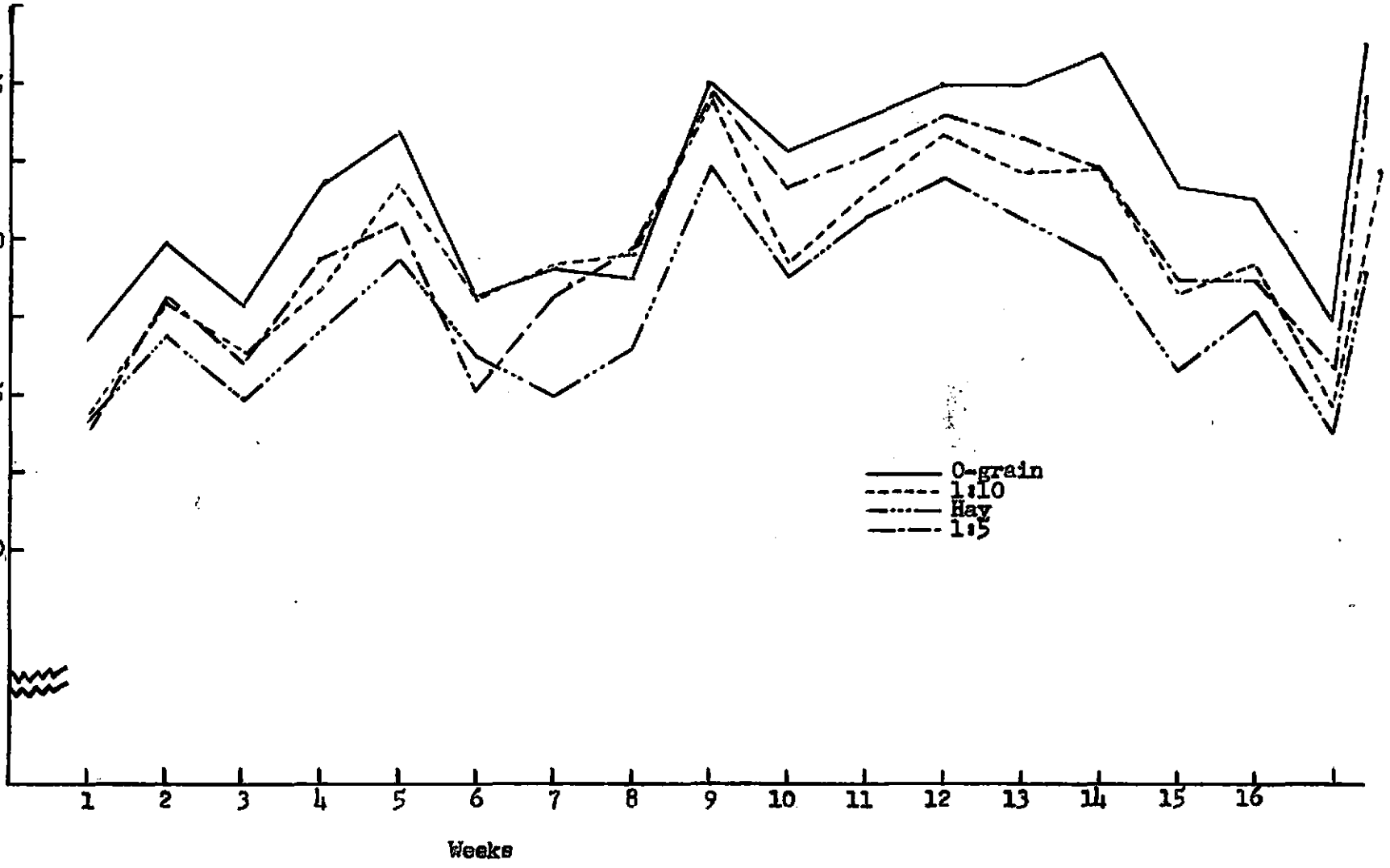

Figure 1. Average daily pasture dry matter consumed (weekly average) by lactating cows fed clipped pasture forage or clipped pasture forage with hay or various amounts of grain for a 122 day period (1956).

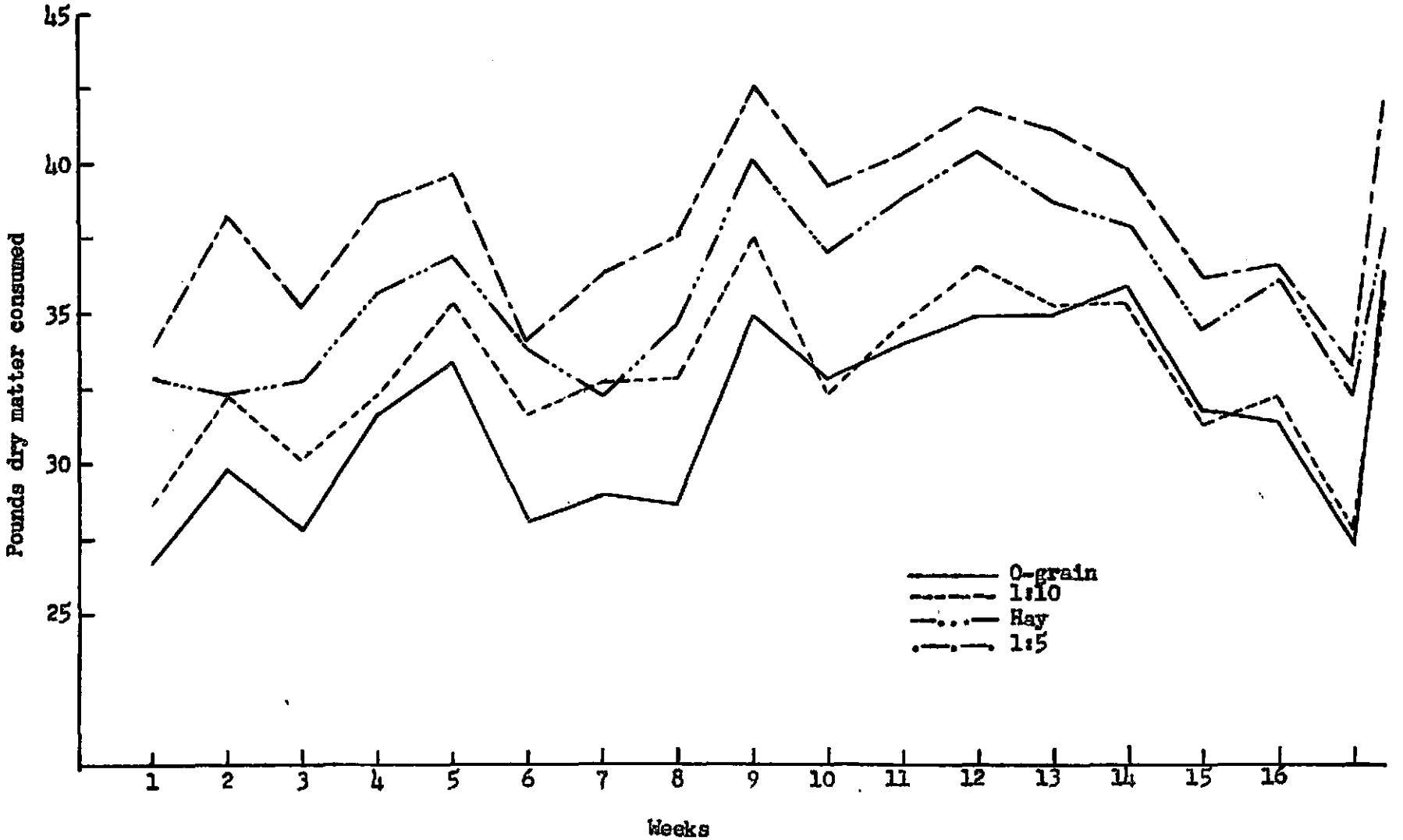

Figure 2. Average daily total dry matter consumed (weekly average) by lactating cows fed clipped pasture forage or clipped pasture forage with hay or various amounts of grain for a 122 day period (1956).

was 3841, 3965, 4510 and 4365 pounds for the 0-grain, 1:10, 1:5 and hay groups respectively. These differences in consumption were statistically significant (P . 05).

The consumption of total digestible nutrients was closely associated with dry matter consumption. The average total digestible nutrient content of the pasture forage was found to be 60 percent (Appendix table 11). The total digestible nutrient content of 50 samples composited from 72 individual samples ranged from 59.27 to 61.99 percent. Crude fiber content increased slightly with increased maturity, while crude protein decreased. However, protein content of the forage tended to increase from one clipping period to the next, throughout the season. The total digestible nutrient content of the alfalfa hay and the grain was 49.2 and 73.2 percent respectively.

Milk and butterfat production

Milk and butterfat production are shown in table 1. During the 10 days prior to the start of this experiment the 0-grain group produced 106.8 percent as much milk as the 1:5 group. The prior production of the 1:10 and hay groups was 82.6 and 95.8 percent, respectively, as much as that of the 1:5 group. The FCM adjusted to this level of prior production is also shown in table 1. The 3 groups fed supplemental grain or hay did not differ noticeably in their adjusted production. Four percent FCM adjusted to prior production was 3661, 4465, 4274 and 4323 for the 0-grain, 1:10, 1:5 and hay groups respectively.

Cows receiving no grain were the lowest producers of milk and declined in milk production at a faster rate than cows fed supplements (figure 3). Persistency levels (average production during trial as a percent of the average 10 day prior production, table 1) was 64.0, 77.3, 78.0 and 76.9 percent for the 0-grain, 1:10, 1:5 and hay groups respectively.

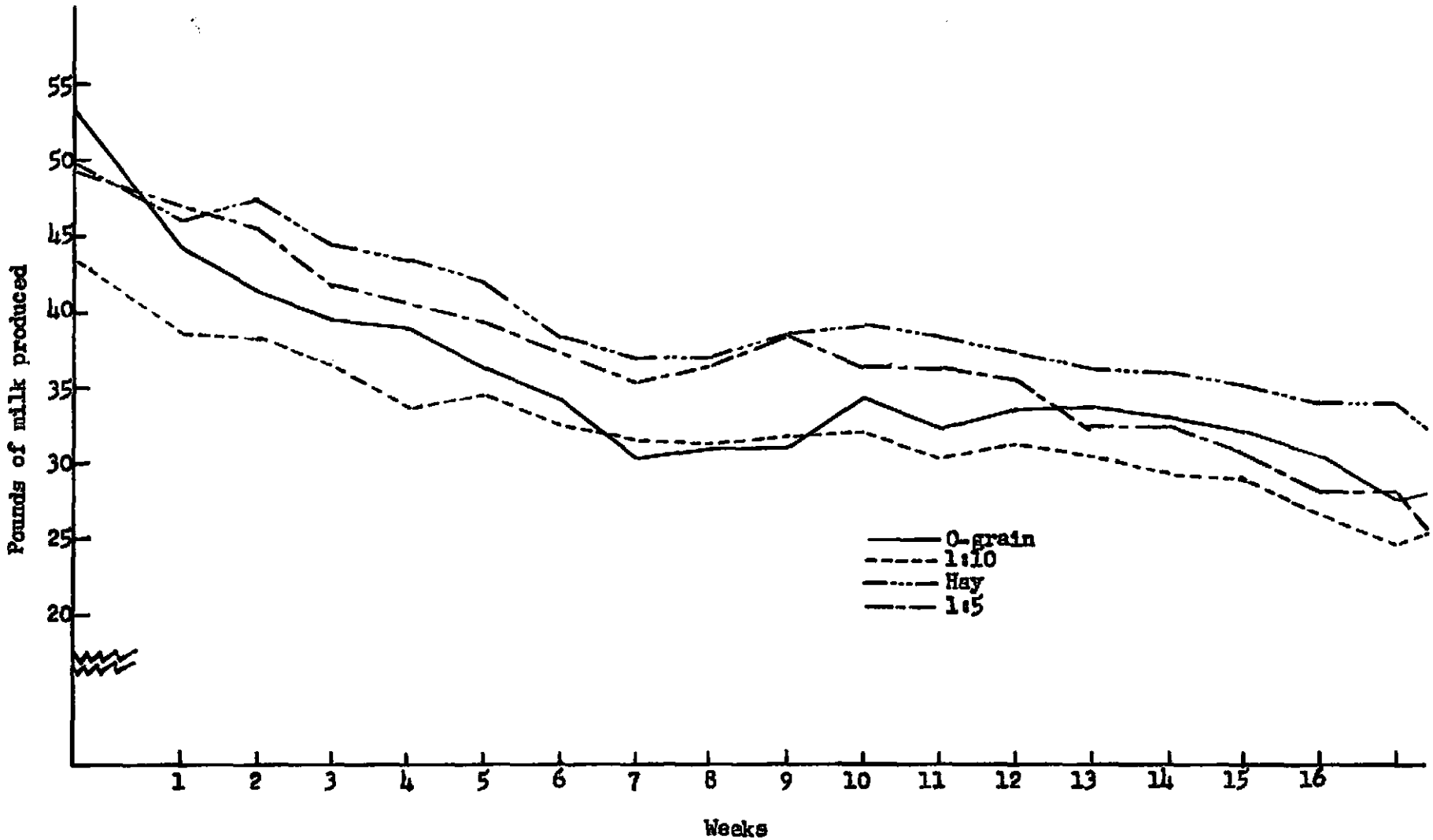

Figure 3. Average daily milk produced (weekly average) by lactating cows fed clipped pasture forage or clipped pasture forage with hay or various amounts of grain for a 122 day period (1956).

According to the supplement consumption and adjusted FCM production, as shown in table 1, the 1:5 group consumed 1010 pounds more grain than the 0-grain group and produced 613 pounds more milk. However, the 1:10 group produced 191 pounds more FCM than the 1:5 group while consuming 590 pounds less grain. The hay group produced 49 pounds more milk than the 1:5 group when 1106 pounds of alfalfa hay replaced 1010 pounds of grain. Results of this experiment indicate that it was not practical to feed grain at the high rate (1:5) to cows fed high yielding pasture. It should also be recognized that pasture alone may not supply sufficient nutrients for high production. Statistical analysis of the data showed that there was no significant difference between groups in milk or butterfat production (P .05). However, because of the few animals on each ration it is not likely that a true difference could have been measured statistically. The trends represented in this experiment are in good agreement with the results of previous experiments on the rate of grain feeding at the Utah Experiment Station.

Body weight

All cows gained weight during the experiment (Appendix table 10). Cow number 9, which received pasture only, gained 166 pounds and produced an average of 36.8 pounds of milk daily. The average gain in weight for the 0-grain, 1:10, 1:5 and hay groups was 94, 104, 92 and 53 pounds respectively. Although cows in the hay group had the least gain it was noted that cow number 102 in that group gained 120 pounds. She also produced the least amount of FCM of any cow in the hay group. The analysis of variance of body weight gains showed no significant difference between groups in this respect. (P .05)

SUMMARY AND CONCLUSIONS

Sixteen lactating Holstein cows were randomly assigned to 4 treatment groups. One group (0-grain) received pasture only. Another group (1:10) received 1 pound of grain for each 10 pounds of milk produced. A third group (1:5) received 1 pound of grain for each 5 pounds of milk produced, while a fourth group (hay) received 10 pounds of hay in addition to pasture.

The results of this experiment indicate that the consumption of pasture dry matter was not measurably affected by supplemental feeding. Average total pasture dry matter consumed per cow was 3841, 3596, 3623, and 3383 pounds for the 0-grain, 1:10, 1:5, and hay groups respectively. These differences were not statistically significant (P .05).

Cows fed supplements consumed more total dry matter and total digestible nutrients than cows fed clipped pasture only. Total dry matter consumption was 3841, 3965, 4510 and 4365 pounds for the 0-grain, 1:10, 1:5 and hay groups respectively. These differences were statistically significant (P .05).

Cows fed supplemental hay or grain tended to be more persistent in milk production than cows receiving clipped pasture only. The level of supplementation had no effect on persistency, since the 3 groups receiving grain or hay did not differ greatly in this respect.

Milk production was adjusted to the level of the average 10 day prior milk production. Feeding the high rate of grain would not be justified on this basis since the 1:10 and hay groups produced more FCM while consuming less total digestible nutrients than the 1:5 group. Statisti-

cal analysis of milk production showed no significant difference between groups (P .05) in this respect.

All cows gained weight on the experiment. Body weight gains were not significantly different between groups (P .05).

Few differences were found to be statistically significant. Nonsignificance was probably due to the lack of a sufficient number of animals on each treatment and to variability between animals within each treatment. Because of the trends noted and the repeatability of results between this experiment and previous work done on the rate of grain feeding at the Utah station, it is probable that had there been more animals the differences between groups would have been significant.

APPENDIX

Table 2. Analysis of variance of total pounds of pasture dry matter consumed per cow by cows receiving clipped pasture, pasture ≠ 1 pound of grain for 10 pounds of milk, pasture ≠ 1 pound of grain for 5 pounds of milk and pasture ≠ 10 pounds of alfalfa hay daily.

Source	d.f.	M. Sq.
Between treatments	3.	140,499*
Within treatments	12	115,187
TOTAL	15	

* Significant when P .05

Table 3. Analysis of variance of total pounds of dry matter consumed per cow by cows receiving clipped pasture, pasture ≠ 1 pound of grain for 10 pounds of milk and pasture ≠ 1 pound of grain for 5 pounds of milk and pasture ≠ 10 pounds of alfalfa hay daily.

Source	d.f.	M. Sq.
Between treatments	3	405,641*
Within treatments	12	98,568
TOTAL	15	

* Significant when P .05

Table 4. Analysis of variance of total pounds digestible nutrients consumed per cow by cows receiving clipped pasture, pasture ∕ 1 pound of grain for 10 pounds of milk, pasture ∕ 1 pound of grain for 5 pounds of milk and pasture ∕ 10 pounds of alfalfa hay daily.

Source	d.f.	M. Sq.
Between treatments	3	187,306*
Within treatments	12	37,424
TOTAL	15	

* Significant when P .05

Table 5. Analysis of variance of total pounds of milk produced per cow by cows receiving clipped pasture, pasture ∕ 1 pound of grain for 10 pounds of milk, pasture ∕ 1 pound of grain for 5 pounds of milk and pasture ∕ 10 pounds of alfalfa hay daily.

Source	d.f.	M. Sq.
Between treatments	3	566,909
Within treatments	12	428,882
TOTAL	15	

Table 6. Analysis of variance of total pounds of 4% FCM produced per cow by cows receiving clipped pasture, pasture + 1 pound grain for 10 pounds of milk, pasture + 1 pound of grain for 5 pounds of milk and pasture + 10 pounds alfalfa hay daily.

Source	d.f.	M. Sq.
Between treatments	3	276,169
Within treatments	12	343,136
TOTAL	15	

Table 7. Analysis of variance of average daily pounds of milk produced as a percent of the prior production of cows receiving clipped pasture, pasture + 1 pound of grain for 10 pounds of milk, pasture + 1 pound of grain for 5 pounds of milk and pasture + 10 pounds of alfalfa hay daily.

Source	d.f.	M. Sq.
Between treatments	3	169.00*
Within treatments	12-	55.195
TOTAL	15	

* Significant when P .10

Table 8. Analysis of variance of body weight gain per cow by cows receiving clipped pasture, pasture + 1 pound of grain for 10 pounds of milk, pasture + 1 pound of grain for 5 pounds of milk and pasture + 10 pounds of alfalfa hay daily.

Source	d.f.	M. Sq.
Between treatments	3	2066
Within treatments	12	2033
TOTAL	15	

Table 9. Feed consumption of lactating dairy cows when fed clipped pasture forage supplemented with alfalfa hay and different amounts of grain for a 122 day period (1956).

Treatment	Cow No.	Pasture Total	Pasture Per Day	Alfalfa Hay	Grain	Dry Matter Pasture	Dry Matter Hay	Dry Matter Grain	Dry Matter TTotal	Dry Matter Per Day
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
	9	19257	158	0	0	4494	0	0	4494	36.8
	47	16077	132	0	0	3754	0	0	3754	30.8
Grain	13	16111	132	0	0	3761	0	0	3761	30.8
0	27	14436	118	0	0	3351	0	0	3351	27.5
	Tot.	65881		0	0	15364	0	0	15364	
	Av.	16470	135	0	0	3841	0	0	3841	31.5
	58	16309	134	0	464.8	3811	0	408.1	4219.1	34.6
	56	15469	127	0	474.0	3608	0	416.2	4024.2	33.0
Grain	49	15912	130	0	345.4	3724	0	303.3	4027.3	33.0
1:10	101	13856	114	0	397.4	3240	0	348.9	3588.9	29.4
	Tot.	61545		0	1681.6	14383	0	1476.4	15859.0	
	Av.	15386	126	0	420.0	3596	0	368.8	3964.8	32.5
	10	15734	129	0	920	3672	0	807.8	4479.8	36.7
	6	16773	137	0	867	3915	0	761.4	4676.4	38.3
Grain	78	15818	130	0	1174	3700	0	1030.5	4730.5	38.8
1:5	64	13692	112	0	1080	3205	0	948.6	4153.6	34.0
	Tot.	62017		0	4041	14492	0	3548.3	18040.0	
	Av.	15504	127	0	1010	3623	0	886.8	4509.8	37.0
	72	13721	113	1051.5	0	3204	933.7	0	4137.7	33.9
	102	14589	120	1099.5	0	3409	976.4	0	4385.4	35.9
Hay	65	14863	122	1146.0	0	3454	1017.6	0	4471.6	36.7
10#/day	45	14821	121	1126.5	0	3464	1000.3	0	4464.3	36.7
	Tot.	57934		4423.5	0	13531	3928.1	0	17459.1	
	Av.	14483	119	1105.9	0	3383	982.0	0	4365.0	35.8

Table 10. Production of lactating dairy cows when fed clipped pasture forage supplemented with alfalfa hay and different amounts of grain, also change in body weights for a 122 day period (1956).

Treatment	Cow No.	Body weight			Production			
			Change			Butter-	4% F.C.M.	
		Initial	Total	Daily	Milk	fat	Total	Per day
		lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
Grain 0	9	1457	+166	+1.36	4583.0	173	4433	36.3
	47	1169	+100	+ .82	4704.0	157	4244	34.8
	13	1120	+ 50	- .42	3892.0	136	3600	29.5
	27	1123	+ 59	+ .48	3465.0	124	3248	26.6
	Tot.	4869	+375		16644.0	591	15530	
	Av.	1217	+ 94	+ .77	4161.0	148	3881	31.8
Grain 1:10	58	1076	+105	+ .86	4377.7	138	3817	31.3
	56	1219	+ 94	+ .77	4391.2	172	4342	35.6
	49	1066	+125	+1.02	3091.3	123	3083	25.3
	101	1122	+ 97	+ .80	3700.6	136	3514	28.8
	Tot.	4483	+417		15560.8	569	14256	
	Av.	1120	+104	+ .85	3890.2	142	3689	30.2
Grain 1:5	10	1394	+ 86	+ .70	4354.0	162	4167	34.2
	6	1325	+158	+1.30	4033.4	136	3649	29.9
	78	1320	+ 99	+ .81	5585.8	188	5056	41.4
	64	1233	+ 27	+ .22	5025.5	148	4226	34.6
	Tot.	5272	+370		18998.7	633	17097	
	Av.	1313	+ 92	+ .75	4749.7	158	4274	35.0
Hay 10#/day	72	1161	+ 33	+ .27	4836.9	166	4419	36.2
	102	1273	+120	+ .98	3444.0	119	3158	25.9
	65	1332	+ 25	+ .21	5013.5	176	4647	38.1
	45	1264	+ 34	+ .28	4659.3	166	4355	35.7
	Tot.	5030	+212		17953.7	626	16579	
	Av.	1257	+ 53	+ .43	4488.4	157	4144	34.0

Table 11. Nutrient content of feeds fed to cows receiving pasture only and pasture plus hay or various levels of grain.

Date	Ether Extract	Digestible Fat	Crude Fiber	Dig. Crude Fiber	Protein	Dig. Protein	Nit. Free Extract	Dig. Nit. Free Ext.	Tot. Dig. Nutrients
	%	53% x %	%	73% %	%	%	%	%	%
5-22-56	1.97	2.35	29.8	21.7	14.06	10.40	36.07	25.25	59.75
5-25-56	2.24	2.67	32.5	23.7	12.75	9.44	36.21	25.35	61.18
5-25-56	1.95	2.32	32.6	23.8	14.31	10.59	34.64	24.25	60.96
5-25-56	2.05	2.44	32.4	23.7	13.25	9.80	35.90	25.13	61.02
5-28-56	2.39	2.85	28.8	21.0	14.81	10.96	35.00	24.50	59.33
6-1-56	2.61	3.11	29.3	21.4	13.94	10.32	36.95	25.86	60.68
6-9-56	2.40	2.86	29.6	21.6	13.69	10.13	37.91	26.54	61.14
6-9-56	2.55	3.04	28.7	21.0	12.31	9.11	37.34	26.14	59.24
6-9-56	2.53	3.02	28.7	21.0	11.62	8.60	38.65	27.06	59.63
6-15-56	2.05	2.44	29.0	21.2	12.69	9.39	38.16	26.71	59.71
6-19-56	2.40	2.86	28.1	20.5	11.62	8.60	38.78	27.15	59.12
6-19-56	2.95	3.52	27.3	19.9	12.12	8.97	38.38	27.18	59.60
6-19-56	2.93	3.49	27.2	19.9	11.88	8.79	38.69	27.08	59.22
6-25-56	3.43	4.09	27.1	19.8	11.00	8.14	39.27	27.49	59.52
6-30-56	2.78	3.32	29.9	21.8	10.50	7.77	38.42	26.89	59.78
6-30-56	2.25	2.68	29.0	21.2	10.62	7.86	39.73	27.81	59.55
6-30-56	2.45	2.92	29.3	21.4	10.69	7.91	39.56	27.69	59.92
7-5-56	2.64	3.15	25.9	18.9	14.38	10.64	38.18	26.72	59.42
7-13-56	3.02	3.60	26.3	19.2	15.12	11.19	36.06	25.24	59.23
7-13-56	3.41	4.07	26.0	19.0	14.69	10.87	37.30	26.11	60.05
7-13-56	3.46	4.13	25.1	18.3	14.75	10.92	38.29	26.80	60.15
7-17-56	3.00	3.58	27.8	20.3	13.50	9.99	38.60	27.02	60.89
7-20-56	3.31	3.95	25.0	18.2	12.62	9.34	42.47	29.59	61.08
7-24-56	3.26	3.89	27.4	20.0	14.12	10.45	37.82	26.74	60.81
7-24-56	3.61	4.30	27.3	19.9	13.75	10.18	38.24	26.77	61.15
7-24-56	3.75	4.47	26.9	19.6	14.00	10.36	38.05	26.64	61.07
7-27-56	3.00	3.58	28.5	20.8	14.56	10.77	36.54	25.58	60.73
8-4-56	2.71	3.23	29.2	21.3	15.06	11.14	36.73	25.71	61.38
8-4-56	3.29	3.92	28.6	20.9	14.94	11.06	37.17	26.02	61.90
8-4-56	2.89	3.45	28.6	20.9	15.38	11.38	37.03	25.92	61.65
8-7-56	2.82	3.36	28.8	21.0	13.62	10.08	39.36	27.55	61.99
8-10-56	3.07	3.66	24.6	18.0	15.50	11.47	40.33	28.23	61.36
8-15-56	2.97	3.54	25.9	18.9	15.25	11.28	38.38	26.87	60.59
8-15-56	2.70	3.22	26.4	19.3	16.06	11.88	37.74	26.42	60.82
8-15-56	2.46	2.93	26.5	19.3	16.19	11.98	37.85	26.50	60.71
8-20-56	2.39	2.85	25.7	18.8	15.56	11.51	39.65	27.76	60.92
8-23-56	2.52	3.00	24.3	17.7	16.31	12.07	39.77	27.84	60.61
8-24-56	2.14	2.55	21.4	15.6	20.62	15.26	36.94	25.86	59.27
8-27-56	2.22	2.65	23.8	17.4	15.88	11.75	41.90	29.33	61.13
8-27-56	2.36	2.81	23.0	16.8	15.19	11.24	42.65	29.86	60.71
8-27-56	2.23	2.66	23.5	17.2	15.69	11.61	41.88	29.32	60.79

Table 11 con't -

8-30-56	1.98	2.36	25.3	18.5	16.75	12.40	38.97	27.28	60.54
8-31-56	2.22	2.65	24.4	17.8	16.81	12.44	39.47	27.63	60.52
9-4-56	2.43	2.90	24.0	17.5	17.69	13.09	37.98	26.59	60.08
9-6-56	1.68	2.00	22.5	16.4	17.75	13.14	39.87	27.91	59.45
9-6-56	2.53	3.02	22.2	16.2	17.62	13.04	39.05	27.34	59.60
9-6-56	2.36	2.81	21.8	15.9	17.88	13.23	39.26	27.48	59.42
9-10-56	1.96	2.34	29.4	21.5	23.19	17.16	26.65	18.66	59.66
9-14-56	2.05	2.44	27.3	19.9	22.81	16.88	29.54	20.68	59.90
9-16-56	2.42	2.88	22.7	16.6	18.12	13.41	38.46	26.92	59.81
9-20-56	2.68	3.20	12.2	8.9	20.62	15.26	46.20	32.34	59.70
51	2.60		24.6		Alfalfa hay		38.12		60.32
8-1-56	1.16	.84	28.9	12.72	14.12	10.02	35.42	24.79	48.37
8-19-56	1.47	1.06	27.3	12.01	12.56	8.92	38.77	27.14	49.13
9-9-56	1.44	1.04	28.8	12.67	13.56	9.63	38.20	26.74	50.08
3	1.36		28.3		Grain		37.46		49.19
8-1-56	0.63	.95	8.5	5.44	11.25	8.83	63.72	57.98	73.20

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