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ALL-YEAR PASTURING WITH AND WITHOUT CONCENTRATES FOR DAIRY COWS

By

BEN P. HAZLEWOOD



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ALL-YEAR PASTURING WITH AND WITHOUT CONCENTRATES FOR DAIRY COWS ¹

By

BEN P. HAZLEWOOD

INTRODUCTION

Pastures are important in the interrelationship of soils, plants, and animals. Soil conditions dictate the extent of legume and grass production. High-quality forage governs livestock production, with grain supplementing rather than dominating the feeding program.

Pastures renew organic matter, prevent soil erosion, and conserve rainfall. They aid in balancing crops, giving more bales of cotton, pounds of tobacco, and bushels of grain, fruits, and vegetables from fewer acres. Pasture and hay crops are the foundation of soil conservation and sound land use.

Generally, Tennessee soils are such that reasonable soil conservation requires a large ratio of pasture to row crops. Under such a system, maximum utilization of forage by livestock is to be expected.

Utilization of the maximum feed from pasture demands high-grade farm management. It involves the art of balancing the physical factors of production at a high level. The result is a highly productive and more permanent agriculture.

ACKNOWLEDGMENT

The author wishes to acknowledge the cooperation of the late Dr. M. Jacob, Dean of the College of Agriculture; and Director Emeritus C. A. Mooers of the Experiment Station, in planning this project.

OBJECT OF THE EXPERIMENT

The object of the experiment was to determine: (1) the results of feeding Jersey cows an all-roughage ration, supplied from all-year grazing, supplemented when necessary by alfalfa hay and silage, and (2) the effect of adding full grain feeding to such a ration.

¹An earlier report on this same subject was published as Circular No. 58, April, 1936.

PLAN OF THE EXPERIMENT

The Station's dairy herd was divided into two groups. The no-grain group was given all-year pasture, alfalfa hay, and silage; the grain group had the same pasture and roughage, with a grain mixture at the rate of 1 pound to each 3 pounds of milk produced. Each cow was placed in one of the groups at the beginning of the dry period, or, in the case of heifers, 60 days before the first calving date. The project was continued for such time as was required for 16 cows to complete 2 successive normal lactations in each group.

Fifteen purebred Jerseys and 1 grade Jersey were used. Each cow was milked for 4 successive normal lactations, 2 without concentrates and 2 with concentrates. A number of cows that were started had to be removed because of disease, injury, or death, and their records were not included.

SOIL CONDITIONS

The soils of the West Tennessee Experiment Station, at Jackson, on which the pasture and feeds used in this experiment were produced, are silt loams well supplied with phosphate. The hay, silage, crimson clover, ryegrass, and sudan-grass pastures were grown on soils recently classified as Lintonia and Olivier. The permanent-pasture sod was produced largely on a soil classified as Calhoun, an inferior type for most crops. Twenty years prior to the beginning of the experiment these soils were considered as worn-out cotton and corn land. Corn yields were 12 to 15 bushels per acre, and 3 to 4 acres were required to produce a bale of cotton. During the 20-year interval the soils were improved gradually by the use of ground limestone, soil-improving crops, and manure in moderate quantity, until the average productive capacity had reached about 50 bushels of corn or 1 bale of cotton per acre.

ALL-YEAR PASTURE

The all-year pasture consisted of a permanent sod of clovers and grasses for the period May 1 to October 31, supplemented at intervals during the "drouth" period of July, August, and September with sudan grass. Pasture for the period November 1 to April 30 consisted of either crimson clover alone or a mixture of crimson clover and ryegrass. Usually the permanent pasture—a mixture of alfalfa and lepedeza; white, red, and hop clovers; and orchard, redbtop, and bermuda grasses—had a growth of 3 to 6 inches. Figure 1 shows permanent pasture in May, with cow W29 in foreground. During the dry period—the latter half of summer, and fall—the bermuda predominated. The emergency pasture from sudan grass was about 18 inches high before grazing was started. Winter pasture, of crimson clover alone and with ryegrass, was seeded early in August, and as a rule made 6 to 12 inches of growth before grazing was begun. Grazing was short in January and February; it usually improved in March, and was excellent in April.

ALFALFA HAY AND SILAGE

The alfalfa hay was of fair to good quality. The silage was made from interplanted corn and sorghum.

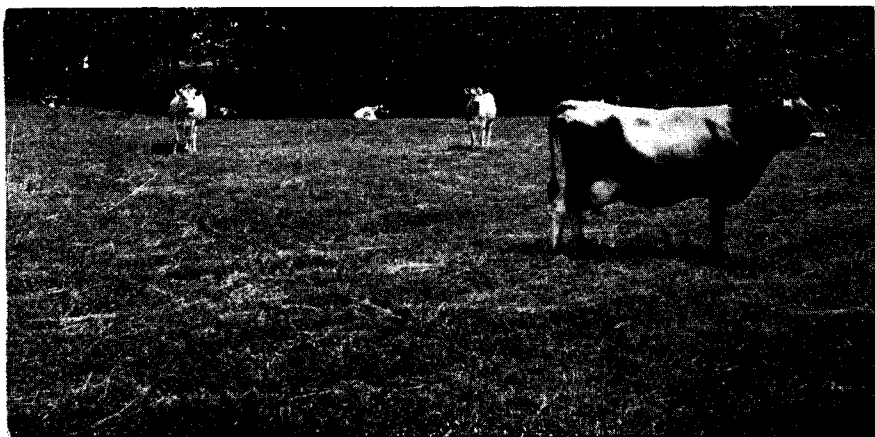


Fig. 1—Permanent pasture during May, with water and shade in background.
Cow W29, in foreground, is in fourth lactation.

CONCENTRATE MIXTURE

The concentrate used was a mixture of equal parts corn-cob-shuck meal, ground barley and oats, and cottonseed meal, with 1 percent salt.

RECORDS

Individual weights, production, and feed consumption were recorded on a calendar-month basis. Except for hay and pasture, individual feed-consumption records were kept. In the case of hay, the cows were fed by groups and the average for a group was used for each individual. Pasture consumption was ascertained by computation of the difference between total digestible nutrients required for maintenance and production, and the total digestible nutrients supplied from barn feeding (4). The total digestible nutrients are calculated estimates, since no analyses were made on grain, hay, silage, or pasturage. Milk production was calculated to a 4-percent fat-corrected milk basis by the Gaines (2) formula. Nutrient requirements for change in body weight were calculated by the method used by Knott and others (3). Individual cow records were made at various ages, and each was calculated (1) to a mature-equivalent basis.

RESULTS

Table 1 shows the milk production of each of the 16 cows for 4 successive lactations, corrected to a 4-percent-fat basis for each lactation.

The first 2 lactation records, except as noted in the table, were made with grain feeding, followed by 2 lactations of no-grain feeding. Considering the 14 cows receiving grain for 2 lactations preceding 2 lactations of no-grain feeding, 7 of the 14 gave their greatest production in the first lactation of no-grain feeding following grain feeding, and 7 in the second lactation. The amount of milk favored the first lactation by 154 pounds.

Table 1—*Whole-milk production*
Corrected to 4% fat basis

Cow	With grain		Without grain	
	Lactation		Lactation	
	1st	2nd	1st	2nd
	Pounds	Pounds	Pounds	Pounds
W31	11921	11505	8061	7879
W31	10543	9794	6853	7201
W43	11083	11488	8493	8054
W54	10721	11111	6989	8010
W56	10601	9591	8356	8155
W60	12703	12459	9564	9211
W63	10550	10375	7271	4473
W45	11564	11210	7114	7502
W50	10389	11111	7646	7675
W59	12279	11207	8000	6384
2182	10196	13584	7798	9792
W38	9904	9404	8373	9136
W37	13429	12394	10479	9057
¹ W29	8916	9265	11220	7302
W14	6461	8244	6146	6565
¹ H9	7895	6651	10894	7709
Total	169185	169393	133257	124105
Average	10572	10587	8329	7757
	10579		8043	

¹No-grain records preceded grain records.

As shown in table 1, the average of 32 records with grain feeding was 10579 pounds of milk; and without grain feeding, 8043 pounds. Roughage feeding alone produced 76 percent as much milk as combined roughage and full-grain feeding.

CALVING RECORDS

The distribution of calving dates for the two groups, during the 4 lactations, was sufficiently even to preclude a date-of-freshening influence on production. Table 2 gives the number of cows freshening each calendar month in the two groups.

Table 2—*Distribution of calving by months for 16 cows, 2 lactations for each group.*

Group	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
Grain												
No. of cows	5	4	1	2	2	5	2	1	2	3	2	3
No-grain												
No. of cows	4	4	2	2	3	5	2	3	0	3	2	2

MILK PRODUCTION BY CALENDAR MONTHS

Both the grain and no-grain groups varied considerably in milk production from season to season. Table 3 gives the average milk production for

the two groups for each month. Figure 2 shows the same data in graph form.

Table 3—Average milk production of grain and no-grain groups, by calendar months, converted to 4-percent fat and calculated to mature-equivalent.

Average period of lactation—sixth month

Group	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Grain	770	850	1026	1100	1005	867	1025	923	849	804	830	931
No-grain	629	655	811	857	936	720	798	701	653	552	614	662

The lowest average production of the grain-fed group came in January, and of the no-grain group in October. The grain-fed group gave the highest production in April and the no-grain group in May. September, October, and November showed the lowest production during any 3 consecutive months for both groups. The highest 3 months were March, April, and May for both groups. Except for the slight differences between low- and peak-production months, the trend of production for the two groups from month to month was the same. The influence of flush pasture during the spring

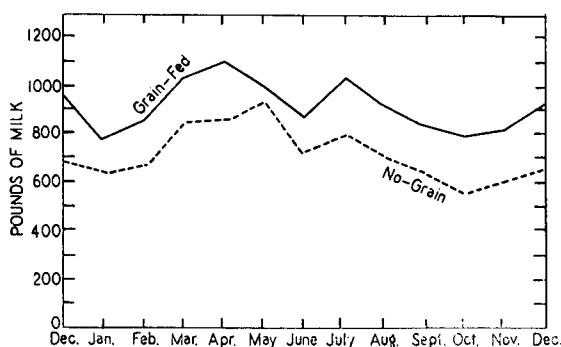


Fig. 2—Milk production by calendar months, based on data in table 3.

months of April and May, and during July and August, when sudan grass was available, is noticeable from the increased production of both groups. Figure 3 shows cows on emergency pasture.



Fig. 3—Sudan grass utilized as an emergency pasture during July.

MILK PRODUCTION BY LACTATION MONTHS

Since the freshening dates of cows in both the grain and no-grain groups were well distributed throughout the year (table 2), an accurate comparison can be made of the lactations of the two groups.

Table 4 and figure 4 show the milk production by lactation months for both groups. Since production was recorded on a calendar-month basis, the first lactation month represents only a part of the month, which was 13 days for each group. The grain-fed group had an average dry period of 64 days preceding a lactation of 314 days. The no-grain group had a dry period of 60 days preceding a lactation of 311 days.

Table 4—Average milk production of grain and no-grain groups, by lactation months, converted to 4-percent fat and calculated to mature-equivalent.

Group	Lactation Months										
	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Grain	545	1279	1222	1122	1067	1017	967	897	846	806	699
No-grain	469	1077	972	884	836	755	731	647	601	537	484

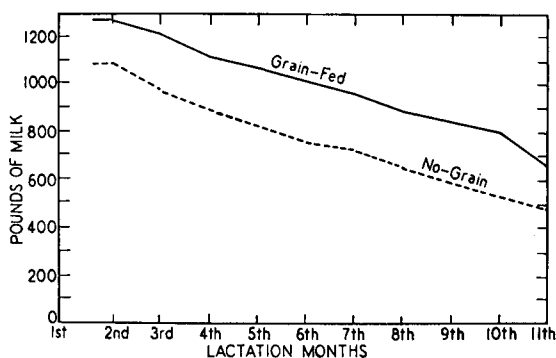


Fig. 4—Milk production by lactation months, based on data in table 4.

The no-grain group declined somewhat more rapidly in production than the grain group. During the first 3 lactation months the production of the no-grain group was 83 percent that of the grain group; for the 4th, 5th, and 6th months, 77 percent; for the 7th, 8th, and 9th months, 73 percent; and for the last 2 months, 69 percent.

BODY WEIGHTS BY LACTATION MONTHS

The average of body weights made on each of the first 3 days after calving served as the initial weight. Thereafter body weights were made the last 3 days of each calendar month during the lactation, and the average was used as the weight for the month. Table 5 and figure 5 show the body weights by lactation months.

Table 5—Average body weights by lactation months.

Group	Initial Wt.	Lactation Months										
		1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Grain	811	791	771	769	776	779	791	801	814	826	837	862
No-grain	862	835	803	801	800	801	810	811	830	849	862	885

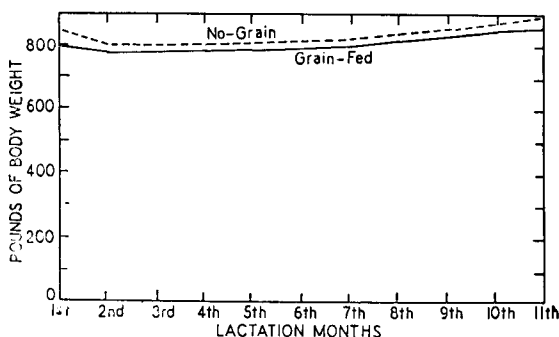


Fig. 5—Body weights by lactation months, based on data in table 5.

Cows fed grain lost weight until the end of the 3rd lactation month. Beginning with the 4th month, a gain was made each month until at the end of the 11th month 51 pounds had been gained above the initial weight. Cows fed no grain lost weight until the end of the 2nd month; after that there was little change in body weight until the 8th lactation month, when an increase began. By the end of the 11th month, 23 pounds had been gained above the initial weight. The average age of cows in the grain group was 3 years and 3 months; in the no-grain group the average age was 4 years and 10 months. The difference in age accounts for the greater weight in the no-grain group.

BODY WEIGHTS BY CALENDAR MONTHS

Body weights were taken on each of the last 3 days of each calendar month. When the stage of lactation for the group averaged earlier or later than the 6th month, adjustment was made to the 6th month in accordance with factors derived from table 5. Table 6 and figure 6 show the average body weights by calendar months.

Seasonal change in body weights was small. The lowest weight for each group was recorded in March, the no-grain group being 39 pounds below the year's average, and the grain group 18 pounds. In the study of table 6 and figure 6, comparison might be made with the calendar-month production of milk, shown in table 3 and figure 2. During the periods of lowest production for both groups, body weights were well sustained.

Table 6—Average body weights by calendar months.

Period of lactation — sixth month

Group	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Grain	802	797	778	789	818	813	782	807	798	788	793	786
No-grain	822	815	785	822	849	843	816	841	853	818	812	815

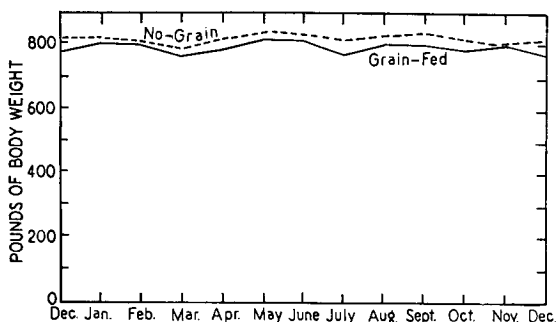


Fig. 6—Body weights by calendar months, based on data in table 6.

DIGESTIBLE-NUTRIENT REQUIREMENTS OF GRAIN-FED COWS AND AMOUNTS SUPPLIED BY THE DIFFERENT FEEDS

Grain-fed cows got from grazing hardly one-half of the total digestible nutrients required for one year's maintenance and production.

Table 7 and figure 7 show the monthly requirements of total digestible nutrients and the amounts supplied by pasture, silage, hay, and grain when grain was fed.

Table 7—Total digestible nutrients required for grain-fed dairy cattle and amounts supplied by the different feeds, by months.

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Required	373	399	435	575	561	407	422	513	412	379	421	472
Supplied by Pasture	—16	41	73	441	452	284	279	351	229	157	127	60
Silage	82	79	76	6	—	—	—	—	15	19	52	72
Hay	184	153	147	32	19	27	31	47	56	88	117	200
Grain	123	126	139	96	90	96	112	115	112	115	125	140

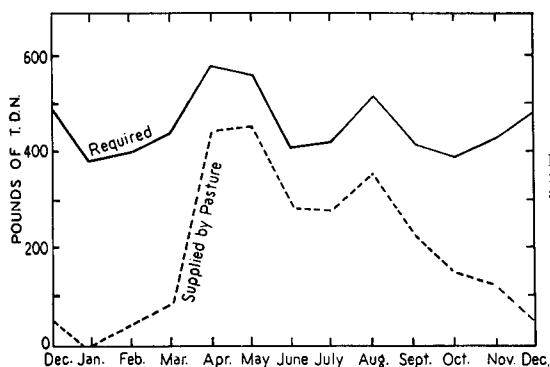


Fig. 7—Total digestible nutrients required for grain-fed dairy cattle, and amount supplied by pasture (see table 7).

Figure 8 shows cows on winter pasture of crimson clover and ryegrass in January. During the months of January, February, and March, pasture supplied only 8 percent of the total digestible-nutrient requirements of grain-fed cattle. The greatest amount, 76 percent, was supplied by pasture during April, May, and June. During July, August, and September, 64 percent of the requirements came from pasture; and in October, November, and December, 27 percent. The higher levels of production were made when the greater amounts came from pasture.



Fig. 8—No-grain cows grazing winter pasture in January.
Left to right: W59, W50, 2182, W31.

DIGESTIBLE-NUTRIENT REQUIREMENTS OF COWS FED NO GRAIN AND AMOUNTS SUPPLIED BY THE DIFFERENT FEEDS

The no-grain cows got from grazing about three-fifths of the required total digestible nutrients for a year's maintenance and production, the remaining two-fifths coming from hay and silage.

Table 8 and figure 9 show the monthly requirements of total digestible nutrients and the amounts supplied by pasture, silage, and hay when cows are fed no grain.

Table 8—Total digestible nutrients required for dairy cattle fed no grain and amounts supplied from the different feeds, by months.

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Required	384	327	369	604	579	368	398	495	406	338	372	416
Supplied by Pasture	48	33	75	560	561	345	373	455	322	192	144	86
Silage	99	87	84	7	1	—	—	6	43	54	73	94
Hay	237	207	210	37	17	23	25	34	41	92	155	236

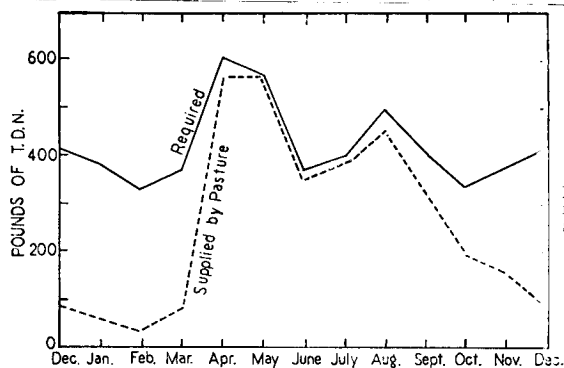


Fig. 9—Total digestible nutrients required for dairy cattle fed no grain, and amount supplied by pasture (see table 8).

During the months of January, February, and March, pasture supplied 14 percent of the total digestible-nutrient requirements of the no-grain cattle. The largest amount, 95 percent, was supplied by pasture during April, May, and June; 89 percent during the 3 months of July, August, and September; and 37 percent in October, November, and December.

Table 9—Average lactation for grain-fed and no-grain groups, including dry-period feed consumption

Item	Grain	No-grain
Age (years and months)	3-3	4-10
Body weight at first milking (lbs.)	811	862
Length of dry period (days)	64	60
Weight of calf born following 2 years in group (lbs.)	57	58
Days in lactation	314	311
Production, fat-corrected milk (lbs.)	8310	7330
Production, F.C.M.E. milk (lbs.)	10579	8043
T.D.N. required for maintenance and production (lbs.)	5326	5033
Source of T.D.N. (lbs.):		
hay	1193	1422
silage	443	581
grain	1427	
pasture	2263	3030
Feed consumed (lbs.):		
hay	2371	2826
silage	2769	3630
grain	1933	
Days and parts of days on pasture:		
permanent	156	155
crimson clover	128	112
sudan grass	21	20

The average lactation required less feed when no grain was fed. Production was reduced by a higher percentage than feed requirements were reduced. To some extent this was due to the fact that slightly larger cows were used in the no-grain group, but more to the fact that maximum production was not obtained from the pasture and roughage available. Table 9 shows averages for grain and no-grain groups, for both the lactation and dry periods.

It is believed that higher production is possible from an all-roughage and pasture ration through better pasture management than was practiced in this experiment. Considering the 12 months of the year on a quarterly basis, pasture supplied 14, 95, 89, and 37 percent, respectively, of the total feed requirements for cows receiving no grain (table 8 and fig. 9). This variation from quarter to quarter indicates an opportunity for improvement, particularly during the fourth quarter. Each additional pound of milk resulting from grain feeding required three-fourths pound of concentrate feed. In addition to the increased production, grain feeding resulted in a saving of other feeds. The feeding of 1933 pounds of concentrates increased milk production 2536 pounds, saved the feeding of 229 pounds of alfalfa hay and 138 pounds of silage, and reduced pasture requirements 25 percent.

It is obvious that the feeding of grain with a good roughage and pasture ration may be either profitable or unprofitable, depending on both the selling

price of milk and the cost of feeds. Under the conditions of this project, it may be unprofitable to feed grain when products are sold on markets affording the lower level of income per unit, but profitable when products are sold on a sufficiently high level. The particular market level at which concentrate feeding is profitable is determined by the relation of the concentrate cost to the market price of milk.

FEEDING OF CONTINUOUS PASTURE AND ROUGHAGE ALONE

During the course of the all-year pasture and roughage feeding experiment, two cows were used to make continuous records without grain feeding. The roughage and pasture feeding was the same as that used for the grain and no-grain groups.

Purebred Jersey cows W49 and W58 were used. These cows were raised in the Station herd on a limited whole-milk (8 pounds daily) and grain ration. The amount of grain fed was limited to a maximum of 4 pounds daily. The feeding of milk and grain was discontinued at the ages of 3 and 6 months, respectively. Afterward, each animal was fed only a pasture and roughage ration. W49 completed 6 lactations, and W58, 5 lactations. Both cows appeared normal when disposed of. Table 10 gives the details of production and reproduction of cow W49. Figure 10 shows cow W49 during the seventh lactation.

Table 10—*Production and reproduction of W49, Fauvic U.T. Luscious 1057053*

Age	Days dry	Birth weight calves	Body wt. beginning lactation	Days in lactation	Milk production ¹
Yr. Mo.	Number	Pounds	Pounds	Number	Pounds
2-2	---	40	572	309	6975
3-3	57	55	718	296	8325
4-2	60	48	740	310	6975
5-3	49	45	757	336	7100
6-3	47	55	763	284	6650
7-4	102	55	807	348	8525
8-4	40	50	830	---	---

¹Calculated mature-equivalent 4-percent milk.



Fig. 10—Cow W49 during seventh lactation.

It will be noted from the details of table 10 that cow W49 reproduced regularly and that milk production was sustained at a normal rate.

Table 11 gives the details of production and reproduction of cow W58. Figure 11 is a picture of W58 made during the sixth lactation.

Table 11—*Production and reproduction of W-58, Torono U. T. Jessie*
1097139

Age	Days dry	Birth-weight calves	Body wt. beginning lactation	Days in lactation	Milk production ¹
Yr. Mo.	Number	Pounds	Pounds	Number	Pounds
2-1	—	55	682	365	7975
3-4	67	55	705	307	7250
4-4	63	55	785	366	9825
5-6	56	50	757	328	8475
6-7	55	55	750	336	9075
7-9	68	55	935	-----	-----

¹Calculated mature-equivalent 4-percent milk.

This cow reproduced normally for 5 continuous lactations. The level of production was higher than for cow W49.

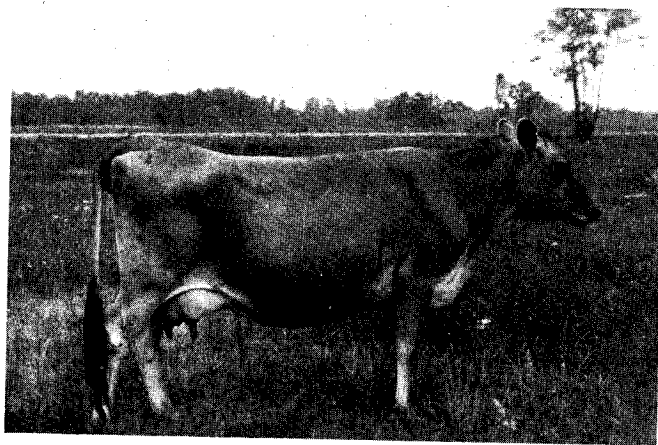


Fig. 11—Cow W58 during sixth lactation.

CONCLUSIONS

1. In 2 successive lactations of full-grain feeding, which were followed by 2 successive lactations of no-grain feeding, the influence on milk production in the first lactation of no-grain feeding was not different from that in the second.

2. The production of cows fed no grain was 76 percent of that of the grain-fed group.

3. Grain-fed and no-grain dairy cattle followed the same seasonal trend of production.

4. Grain-fed cows were more persistent in production than the no-grain cows.

5. Body weights and production by calendar months did not follow the same trend. Body weights were sustained when production declined. Body weights of neither group showed much seasonal variation. The greatest change was in the month of March for no-grain cows. March body weight for this group was 30 pounds less than February, and 39 pounds below the year's average.

6. Cows fed no grain lost body weight more rapidly after freshening and gained less than grain-fed cows. During lactation, the grain-fed cows gained 51 pounds of body weight and the no-grain cows gained 23 pounds.

7. Grain-fed cows got 43 percent of their total feed supply from grazing. The largest amount of nutrients from grazing was supplied during April, May, and June.

8. No-grain cows got 60 percent of their total feed supply from grazing. Pasture furnished 95 percent of the feed supply during April, May, and June. Pasture during January, February, and March, at the lowest period, supplied 14 percent of the total feed supply.

9. Birth weight of calves after grain-feeding lactations averaged 57 pounds; after no-grain feeding, 58 pounds.

10. Lower-level-income markets favor all roughage and pasture ration, with less than maximum production, for the greatest net return. The reverse is true for high markets.

11. Jersey cows will produce and reproduce normally when fed only all-year pasture, alfalfa hay, and silage.

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