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High-Level Grain Feeding For Dairy Cows in Idaho

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SUMMARY

In a 4-year study, a total of 60 Holstein cows were paired and fed a high-level grain ration (Group 1) or grain according to production (Group 2). Feeding period was 350 days 1 year and 364 days each of the last 3 years. All cows were fed 10.4 pounds of dry matter daily as corn silage. The cows in Group 1 received 5 pounds of alfalfa hay and grain ad libitum to the point of at least 1 percent weighback. Group 1 received an additional daily protein supplement of 3 pounds of soybean oil meal the first year, 1 pound the second year, 5 pounds of alfalfa hay the third year and 0.3 pounds of urea the fourth year. Group 2 received 1 pound of grain per 3.5 pounds of 4% FCM and alfalfa hay ad libitum to the point of at least 1 percent weighback.

The cows on heavy grain in Group 1 consumed an average of 12,238 pounds of corn silage, 1,956 pounds hay and 8,588 pounds grain for a total of 10,127 pounds of total digestible nutrients per cow per year. This group of cows had an average per cow total feed cost of \$362.48 and a feed cost of \$3.11 per 100 pounds of 4% FCM. They produced 446 pounds of butterfat, 1,048 pounds solids-not-fat, 444 pounds protein and 11,650 pounds of 4% FCM, and gained 175 pounds in body weight.

The cows in Group 2 (control) consumed a yearly average of 12,930 pounds of corn silage, 6,663 pounds hay and 3,031 pounds grain for a total of 7,999 pounds of total digestible nutrients at a total yearly cost of \$239.12 per cow. The feed cost per 100 pounds of 4% FCM was \$2.15. They produced 421 pounds of butterfat, 995 pounds of solids-not-fat, 417 pounds of protein and 11,128 pounds of 4% FCM, and gained 143 pounds body weight.

There was no significant difference in production in 3 of the 4 years. The ration had no significant effect on mastitis or reproduction. Two cows had evidence of foundering on the heavy-grain feeding ration.

CONCLUSIONS

This study indicates the rate of grain feeding to dairy cows should be governed only by the relative cost of grain, forage, labor and milk prices. There will need to be some culling of animals that do not respond to high levels of grain feeding. With proper management the cow can adjust to the consumption of high amounts of grain with no ill effects to her health.

At the present time a good quality forage should make up approximately 70 percent of the cow's ration in Idaho to be most economical.

High-Level Grain Feeding For Dairy Cows in Idaho

David L. Thacker and R. H. Ross

One problem that Idaho dairymen face is how to feed the cow more energy for higher milk production. Feeding high levels of grain may help to correct this problem. The price of grain has remained about the same, but with the use of improved varieties, fertilizers and harvesting methods, farmers are now able to obtain much higher yields per acre. This makes the total cost of energy from grain production competitive with the cost of energy from roughages.

The need to feed more energy in the cow's ration leads one to question the economy of feeding hay to the milking cow. If it were possible to feed grain free choice, or at least in large portions, to the average dairy herd, there could be savings in labor and storage and an increase in production.

Huffman (8) in a review of literature reported that heavy grain feeding had no effect on mastitis, udder edema or cows being "off feed." Others (1, 2, 4, 5, 6, 7, and 9) have supported the hypothesis that heavy grain feeding has no adverse effects on the general health of cows. Conditions that have been measured with no significant effects are: days to first estrus, days open, total services required for conception, incidence or severity of udder edema, mastitis, metritis, ketosis and milk fever.

High grain feeding has not produced consistent increases in milk production. Some researchers (6, 5, 10, 12, 14, 16) have reported no significant or economical increase in the cow's production while others (2, 3, 7, 9, 11, 13, 15) reported significant gains. The cows consistently consumed more energy in all trials on a high level of grain feeding and were able to maintain or gain in body weight compared with cows fed according to production or by current feeding standards. This information was obtained with cows on feeding trials for one lactation or less. The 4-year study reported here was initiated to compare the response and economy of feeding an average herd of cows all the grain they would consume plus only enough roughage to maintain the butterfat test.

EXPERIMENTAL PROCEDURE

Holstein cows were paired as equally as possible based upon level of production, size and past history of mastitis and age, and then were randomly assigned to either high-level grain ration or the control ration. Selected for each ration within each year were cows with a history of mastitis, aged cows that were capable of producing more than 15,000 pounds of milk, aged cows that had never produced more than 10,000 pounds of milk and first calf heifers.

The feeding schedule is presented in Table 1. The cows received a minimum of 15 pounds of hay equivalent as hay and silage to maintain the percentage of butterfat. They received sufficient amounts of feed so that there would be between 1 and 5 percent weighback each day. The cows were fed corn silage at 5 p.m., hay at 8 a.m. and grain or hay at noon. The cows received a portion of the grain twice a day while being milked. The grain was a mixture of $\frac{1}{3}$ corn, $\frac{1}{3}$ barley and $\frac{1}{3}$ dried molasses beet pulp. Alfalfa hay consisted of first cutting harvested at 35 percent moisture and barn cured. The average composition of feeds used in this study is presented in Table 2.

The cows were fed and had access to trace mineralized salt and a calcium-phosphate mineral supplement. Daily records were kept on feed consumption and milk production. Milk was tested biweekly for butterfat using the Babcock method, for solids-not-fat, using the Golding plastic beads, and for mastitis, using the Whiteside test. The percent protein was determined once a month using the orange dye method.

The cows were weighed monthly.

In 1962-63, 12 Holstein cows were fed for 350 days. The cows on

Table 1. Daily feeding schedule.

	Controls				High-level grain			
	No. days	Silage	Hay	Grain	Silage	Hay	Protein meal	Grain
1962-63	350	40	°1	°°2	40	5#	3	°1
1963-64	364	35 ³	°	°°	35 ³	5#	1	°
1964-65	364	40	°	°°	40	10#	0	°
1965-66 ⁴	364	40	°	°°	40	5#	0 ⁴	°

¹ Ad lib to the point that there was at least a 1 percent weighback of one of the feeds.

² Grain was fed at a rate of 1 pound per 3.5 pounds of 4% FCM.

³ Dry matter in 1963-64 was equal to or slightly higher than the other 3 years.

⁴ Both groups in 1965-66 were fed 0.3 pounds of 43 percent protein urea.

the high-level grain feeding received 3 pounds of cottonseed meal (45% protein) in addition to the grain mixture.

In 1963-64, 16 Holstein cows were fed for 364 days. The cows on high-level grain received 1 pound of soybean oil meal (50% protein) with the silage feeding.

In 1964-65, 16 Holstein cows were fed for 364 days. The 8 cows on high-level grain feeding were fed 10 pounds of alfalfa hay as a source of additional protein. This additional 5 pounds of hay replaced the cottonseed meal or soybean oil meal used previously.

In 1965-66, 16 Holstein cows were fed for 364 days. The cows on both the control and high-level grain rations were fed 0.3 pounds of urea per day. In the first 3 years of this study the cows had a deprived appetite for urine.

The following costs were used to determine the cost per 100 pounds of 4% fat-corrected milk (FCM): alfalfa hay, \$25 per ton; corn silage, \$9 per ton; ground grain mixture, \$60 per ton; protein meal, \$90 per ton; trace mineralized salt and calcium-phosphate mixture, \$6.25 per hundredweight.

Table 2. Composition of feed stuff on a moisture-free basis.

	Fat	Crude fiber	Protein	Nitrogen free extract	Ash	Ca	P
	%	%	%	%	%	%	%
1962-63							
Alfalfa	1.50	22.02	18.18	47.18	11.11	0.81	0.23
Corn silage	2.37	11.24	7.01	72.45	6.93	0.23	0.19
Shelled corn	5.88	2.15	9.92	80.40	1.66	0.08	0.33
Barley	1.94	5.48	16.87	72.55	3.15	0.13	0.35
Dried beet pulp	0.68	14.30	12.20	66.40	6.41	0.26	0.08
1963-64							
Alfalfa	2.30	33.44	13.73	43.29	7.18	1.52	0.20
Corn Silage	1.54	26.12	6.05	58.99	7.30	0.58	0.20
Shelled corn	5.70	3.20	9.40	73.75	1.69	0.18	0.37
Barley	1.92	11.57	11.76	71.02	3.73	0.53	0.40
Dried beet pulp	0.26	15.18	11.42	66.94	6.33	1.74	0.08
1964-65							
Alfalfa	1.31	29.38	18.59	40.08	10.63	1.70	0.26
Corn silage	3.05	19.42	8.25	62.78	6.49	0.34	0.25
Shelled corn	2.33	2.22	10.39	81.64	1.69	0.13	0.13
Barley	1.49	5.81	12.68	76.93	3.09	0.13	0.30
Dried beet pulp	0.55	15.54	12.87	64.21	6.84	0.34	0.08
1965-66							
Alfalfa	0.95	27.97	15.89	44.49	10.69	1.50	0.18
Corn silage	1.73	26.32	8.03	56.30	7.62	0.32	0.24
Shelled corn	1.99	2.49	10.27	83.67	1.58	0.09	0.27
Barley	0.58	6.94	12.19	77.02	3.26	0.36	0.45
Dried beet pulp	0.02	16.19	12.18	65.04	6.57	0.50	0.09

RESULTS

The 4-year average and each yearly average feed consumption and cost of producing 100 pounds of 4% FCM are given in Table 3. The results for individual cows by years are given in Tables 6, 8, 10 and 12. The cows on the high-level grain ration consumed an average of 28.2 pounds of total digestible nutrients (TDN) per day while the cows on the control ration consumed 22.1 pounds. Statistically, the high-level grain cows consumed significantly ($P \leq 0.01$) more TDN 3 years out of 4.

The 4-year average and the yearly average for each year for milk production and for butterfat, solids-not-fat, protein and the percentage of each, and the change in body weight are given in Table 4. The results for individual cows by years are given in Tables 7, 9, 11 and 13. Statistically significant differences in production were obtained only in the fourth year of the study. The cows on high-level grain feeding produced significantly ($P \leq .05$) more pounds of butterfat, protein, solids-not-fat and milk than the cows on the control ration.

1962-63

Cows on the control ration produced more pounds of butterfat, solids-not-fat, protein, milk, 4% FCM and gained more body weight than the cows on the high-level grain ration. One cow was partially foundered when on full feed on the high-level grain ration. When the rate of grain feeding was maintained at 30 pounds per day, she showed no signs of founder. A second cow, on the high-level ration, freshened with ketosis and was incurable until she was removed from the experiment and turned out to pasture. All of the cows in the last half of their lactation developed a depraved appetite for urine.

The cows on the control ration consumed approximately 1,500 pounds more alfalfa hay than they did in any of the other 3 years. The alfalfa hay, corn silage and barley were of exceptionally high quality. The fiber content was low for the alfalfa hay and corn silage and the protein content of the barley was high (Table 2). The cows on the control ration produced milk at a feed cost of \$2.23 per hundred pounds while the cows on the high-level grain ration had a feed cost of \$3.34 per hundred pounds of 4% FCM.

1963-64

The cows on high-level grain ration consumed more grain than in any of the 4 years studied, yet there was the least amount of digestive disturbances. One cow on the high-level grain ration was off feed for 8 days after being on the ration at full feed for 280 days. The cows on the high-level grain ration had their highest rate of production. Milk

production for cows on the control ration was very similar to that in the first year but higher than the other 2 years. The cows on the high-level grain ration had a feed cost per 100 pounds of 4% FCM of \$3.38 which was \$1.31 higher than for the cows on the control ration.

1964-65

Protein for the cows on the high-level grain feeding was supplied by feeding 10 pounds of alfalfa hay containing more than 18 percent crude protein. The feed cost per 100 pounds of 4% FCM for the cows on high-level grain ration was \$2.86 which was \$0.69 higher than for the control ration. The cows on the high-level grain ration consumed less than one-half as much grain as during the other 3 years but production was second highest at 11,963 pounds of 4% FCM. The groups contained two pairs of low producing young cows.

1965-66

The addition of urea at the rate of 0.3 pounds per day per cow on both rations had no effect on the depraved appetites that had been experienced throughout this study. Four cows (2 pairs) had severe cases of yeast-caused mastitis. One cow in the control group milked for only 150 days. The other three cows continued to milk at reduced rates throughout their lactation. Since the cows had been paired and the level of production for the year was quite similar, their data has been included in the results.

Throughout the 4-year study the percent protein and solids-not-fat in the milk from the cows on high-level grain feeding was equal to or slightly higher than that produced by the cows on the control ration. It averaged 0.11 percent higher for protein and 0.13 percent higher for solids-not-fat. Butterfat percentage was the highest for the cows on high-level grain feeding 3 of the 4 years with an increase of 0.1 percent. Feeding 15 pounds of roughage (dry basis) was sufficient to maintain the percent butterfat in the milk.

It was calculated that the rations for both the control and high-level grain groups supplied adequate protein to meet the needs of the cows. There was more variation in the amount of fiber in the ration than had been originally planned. In 1962-63 the fiber content in the total ration was 10.55 percent for the cows on the high-level grain ration; in 1964-65 it was 16.36 percent. The control ration was 16.55 percent fiber in 1962-63 and 25.08 percent in 1964-65. Kesler and Spahr (9) have presented evidence that the dry matter fiber content should be above 13 percent. This lack of fiber the first year may be part of the cause for foundering and other digestive problems experienced and the high rate of production obtained with the controls.

Table 3. A 4-year summary of feed consumption and feed costs for Holstein cows on high-level and controlled grain feeding.

Year	Silage	Hay	Grain	TDN	Bone meal	Protein supplement	Cost of feed	Cost per 100 lb. 4% milk
1962-63	lb.	lb.	lb.	lb.	lb.	lb.		
High grain feeding avg/cow	11,998	1,880	7,539	9,128	102	864	\$353.40	\$3.34
Controlled grain feeding avg/cow	12,515	8,154	2,933	8,497	102	0	259.09	2.23
1963-64								
High grain feeding avg/cow	10,994	1,985	10,536	12,262	104	362	414.00	3.38
Controlled grain feeding avg/cow	11,999	6,794	3,391	8,902	104	0	247.99	2.07
1964-65								
High grain feeding avg/cow	12,421	3,321	7,928	9,908	104	0	341.77	2.86
Controlled grain feeding avg/cow	13,459	6,301	2,865	7,567	104	0	231.81	2.17
1965-66								
High grain feeding avg/cow	13,537	1,636	8,348	9,210	104	109 ¹	338.46	2.87
Controlled grain feeding avg/cow	13,747	5,403	2,934	2,030	104	109 ¹	224.07	2.17
4-Year Average								
High grain feeding avg/cow	12,238	1,956	8,588	10,127	104		362.48	3.11
Controlled grain feeding avg/cow	12,930	6,663	3,031	7,999	104		239.12	2.15

¹Protein supplement was 0.3 pounds of urea fed daily to both groups of cows.

Table 4. A 4-year summary of milk, butterfat, solids-not-fat, and protein production by Holstein cows on high level and controlled grain feeding.

Year	Butterfat		Solids-not-fat		Protein		4% milk	Total milk	Gain body weight
	lb.	%	lb.	%	lb.	%	lb.	lb.	lb.
1962-63									
High grain feeding avg/cow	401	3.52	959	8.43	423	3.71	10,571	11,382	204
Controlled grain feeding avg/cow	428	3.35	1,040	8.14	439	3.37	11,530	12,775	231
1963-64									
High grain feeding avg/cow	466	3.55	1,110	8.44	462	3.52	12,258	13,153	97
Controlled grain feeding avg/cow	461	3.63	1,043	8.22	446	3.52	11,987	12,684	137
1964-65									
High grain feeding avg/cow	456	3.57	1,088	8.51	450	3.52	11,963	12,793	181
Controlled grain feeding avg/cow	398	3.38	987	8.38	406	3.45	10,686	11,786	87
1965-66									
High grain feeding avg/cow	462	3.78	1,035	8.48	440	3.61	11,809	12,206	218
Controlled grain feeding avg/cow	398	3.67	909	8.37	376	3.47	10,318	10,854	116
4-Year Average									
High grain feeding avg/cow	446	3.60	1,048	8.46	444	3.58	11,650	12,383	175
Controlled grain feeding avg/cow	421	3.50	995	8.27	417	3.47	11,128	12,025	143

Mastitis

The summary of the biweekly Whiteside determinations is given in Table 5. Each year there was one cow on each treatment that contributed most of the 3 and 4 readings. All cases that had a 1 or 2 reading required no treatment other than correcting milking procedures. Drug treatments for the 3 and 4 readings were based on sensitivity tests. There was no consistent type of infectious agent present in the sensitivity tests except the yeast observed in 4 cows during 1965-66.

Table 5. Summary of 4 years Whiteside tests for mastitis for cows on high-level and controlled grain feeding expressed as the number of individual tests for each reading on the Whiteside scale.

	Whiteside Readings				
	0	1	2	3	4
High-level grain feeding	606	79	41	37	11
Controlled grain feeding	730	88	57	18	6

Reproduction

The breeding efficiency of the cows in both groups was the same over the four years.

The 30 cows on the high-level grain ration were bred a total of 63 times and 26 calves were born. Four cows did not conceive. One was a nymphomaniac, one had a uterine infection and two first-calf cows were not bred because of type. The 30 cows on the control ration were bred a total of 66 times and 27 calves were born. Three cows did not conceive. One was a nymphomaniac, one had a uterine infection and one first-calf cow was not bred because of type.

DISCUSSION

In the 4-year study there was a large apparent loss of energy from feeding high levels of grain. Although the experiment was designed to cover a wide range in levels of individual production, the calculated energy did not appear as milk or gain in body weight. Compared to control heifers, the high-level first-calf heifers made more efficient use of the extra energy by increasing body growth and reserves for greater production the following lactation whether they continued on the experiment or were returned to the herd. The heifers reached a maximum grain consumption of only 30 pounds per day while several of the mature cows consumed all their roughage and 46 pounds of grain daily.

The ratio of total pounds of roughage to total pounds of grain for the cows on high-level grain varied from 27:73 for the mature cows for a period of 3 months during peak production to an overall 4-year average of 40:60. The cows on the control ration varied from a high of 68:32 to an over-all 4-year average of 78:22.

Feed cost for the cows on high-level grain feeding was significantly ($P \leq 0.01$) higher than for the cows on the control ration. Analysis of feed costs by 2-week intervals for the total lactation likewise showed that the cost per 100 pounds of 4% FCM was higher for cows on the high-level grain ration than for the control cows. Using only pairs of cows where at least one cow of the pair produced 15,000 pounds 4% FCM or more, the feed cost for the high-level grain group was \$1 higher per 100 pounds 4% FCM than for the control ration.

In this study grain was fed to the control cows at the rate of 1 pound of grain to 3.5 pounds of fat-corrected milk calculated every other week. Over the 4-year study the amount of grain consumed was 1 pound of grain per 3.66 pounds of FCM produced. The ratio obtained to actual milk produced was 1 pound of grain per 3.94 pounds of milk. The cows on the control ration in 1962-63 did not consume all the grain that was fed. They consumed only 1 pound of grain to 3.9 pounds of 4% FCM or 4.4 pounds of actual milk produced.

Cows receiving the high-level grain ration with limited roughage consumed an average 1 pound of grain per 1.35 pounds of 4% FCM or 1.4 pounds per actual milk produced. The highest rate of grain consumption was obtained in 1963-64 when the cows consumed 1 pound of grain per 1.2 pounds of 4% FCM.

Table 6. A comparison of feed consumption and feed cost for 12 Holstein cows on high-level and controlled grain feeding for 350 days. (1962-63)

Pair no.	Cow no. ^o	Silage	Hay	Grain	Cotton seed meal	TDN	Cost of feed	Feed cost
								per 100 lb. 4% milk
		lb.	lb.	lb.	lb.	lb.		
1	83	12,835	1,798	8,956	875	10,317	\$399.25	\$3.18
	84	12,841	8,787	3,066	---	8,975	270.51	2.24
2	182	11,689	1,887	7,675	875	9,168	356.74	3.36
	181	11,613	8,392	3,215	---	8,684	264.10	2.09
3	204	11,121	1,815	6,383	815	8,058	311.08	3.39
	196	11,993	6,615	2,734	---	7,449	229.59	2.60
4	207	12,371	2,023	7,136	875	8,955	345.35	4.18
	200	12,903	8,663	2,640	---	8,617	256.47	2.12
5	229	11,869	1,990	7,699	875	9,302	359.60	2.78
	224	12,698	8,387	2,569	---	8,367	249.95	2.31
6	56	12,101	1,769	7,383	875	8,965	348.39	3.53
	48	13,042	8,082	3,376	---	8,888	271.92	2.13
Total for high-level grain feeding		71,986	11,282	45,232	5,190	54,765	2,120.41	
Avg/cow		11,997.7	1,880	7,539.4	864	9,127.5	353.40	3.34
Avg/cow/day		34.3	5.4	21.5	2.4	25.4	1.01	
Total for controlled grain feeding		75,090	48,926	17,600	0	50,980	1,542.54	
Avg/cow		12,515	8,154.3	2,933.3	---	8,496.7	259.09	2.23
Avg/cow/day		35.8	23.3	8.1	---	24.3	.74	

^oFirst cow in each pair is on high-level grain feeding.

Table 7. Comparison of milk, butterfat, solids-not-fat, and protein produced by 12 Holstein cows on high-level and controlled grain feeding for 350 days. (1962-63)

Pair no.	Cow no.*	Butterfat		Solids-not-fat		Protein		Total Milk	4% Milk	Gain body wt.
		lb.	%	lb.	%	lb.	%	lb.	lb.	lb.
1	83	462	3.27	1,158	8.21	547	3.87	14,107	12,573	261
	84	442	3.26	1,093	8.06	451	3.33	13,544	12,055	229
2	182	401	3.47	915	7.94	376	3.26	11,531	10,623	3
	181	441	2.92	1,111	7.34	436	2.88	15,120	12,666	122
3	204	350	3.56	847	8.60	364	3.70	9,840	9,185	258
	196	318	3.14	852	8.42	395	3.45	10,127	8,823	352
4	207	324	3.81	7,725	8.54	322	3.79	8,497	8,256	242
	200	473	3.79	1,058	8.49	465	3.73	12,455	12,073	275
5	229	500	3.67	1,208	8.88	531	3.90	13,608	12,935	343
	224	433	4.01	944	8.74	388	3.59	10,803	10,822	326
6	56	371	3.49	903	8.43	396	3.70	10,707	9,856	114
	48	460	3.15	1,183	8.10	497	3.40	14,599	12,744	81
Total for high-level grain feeding		2,408		5,756		2,536		68,290	63,428	1,221
Avg/cow		401.2	3.52	959.3	8.43	422.7	3.71	11,381.7	10,571	203.5
Avg/cow/day		1.15		2.74		1.21		32.5	30.2	.58
Total for controlled grain feeding		2,567		6,241		2,632		76,648	69,183	1,385
Avg/cow/day		427.8	3.35	1,040.2	8.14	438.7	3.37	12,774.7	11,530.5	230.8
Avg/cow/day		1.22		2.97		1.23		36.5	32.9	.66

*First cow in each pair is on high-level grain feeding.

Table 8. A comparison of feed consumption and feed cost for 16 Holstein cows on high-level and controlled grain feeding for 364 days. (1963-64)

Pair no.	Cow no. ^o	Silage	Hay	Grain	Soybean meal	TDN	Cost of feed	Feed cost
								per 100 lb. 4% milk
		lb.	lb.	lb.	lb.	lb.		
1	20	11,008	1,707	10,057	364	11,746	\$396.29	\$3.38
	84	11,774	6,594	3,432	---	8,775	245.71	2.32
2	194	11,104	1,861	10,795	364	12,444	420.82	3.35
	196	11,968	6,503	3,117	---	8,528	236.01	2.00
3	200	10,631	2,709	11,740	364	13,482	457.63	3.58
	205	12,454	8,339	3,577	---	9,905	274.94	2.16
4	208	10,859	1,763	10,115	364	11,788	398.08	3.79
	207	11,909	5,048	2,900	---	7,655	210.83	2.06
5	225	11,899	2,034	11,408	364	13,206	444.92	3.06
	221	12,354	9,188	4,158	---	10,763	302.55	2.13
6	229	10,506	2,178	11,793	364	13,222	452.03	2.95
	224	11,694	8,333	4,078	---	10,115	286.49	1.81
7	244	10,588	1,940	3,341	350	10,385	345.18	4.09
	241	12,347	5,722	2,816	---	8,004	218.89	2.14
8	247	11,361	1,689	10,037	364	11,823	397.07	3.27
	245	11,494	4,632	3,050	---	7,474	208.47	2.03
Total for high-level grain feeding		87,956	15,881	84,292	2,898	98,096	3,312.02	
Avg/cow		10,994	1,985	10,536	362	12,262	414.00	3.38
Avg/cow/day		30.1	5.5	28.9	1	33.7	1.14	
Total for controlled grain feeding		95,994	54,359	27,128	---	71,219	1,983.89	
Avg/cow		11,999	6,794	3,391	---	8,902	247.99	2.07
Avg/cow/day		33.0	18.6	9.3	---	24.5	.68	

^oFirst cow in each pair is on high-level grain feeding.

Table 9. Comparison of milk, butterfat, solids-not-fat and protein produced by 16 Holstein cows on high-level and controlled grain feeding for 364 days. (1963-64)

Pair no.	Cow no. ^a	Butterfat		Solids-not-fat		Protein		Total Milk	4% Milk	Gain body wt.
		lb.	%	lb.	%	lb.	%	lb.	lb.	lb.
1	20	436	3.37	1,658	8.35	460	3.56	12,938	11,720	153
	84	375	3.02	952	7.65	420	3.38	12,440	10,603	258
2	194	457	3.20	1,168	8.19	473	3.32	14,266	12,556	69
	196	432	3.26	1,076	8.12	459	3.46	13,254	11,780	176
3	200	504	3.85	1,128	8.61	483	3.69	13,095	12,795	7
	205	486	3.56	1,134	8.31	486	3.56	13,655	12,754	13
4	208	428	4.20	880	8.63	384	3.76	10,204	10,508	210
	207	399	3.74	842	7.89	354	3.32	10,670	10,251	72
5	225	540	3.34	1,305	8.08	543	3.36	16,153	14,563	99
	221	557	3.81	1,214	8.31	531	3.63	14,615	14,199	308
6	229	562	3.54	1,428	8.67	558	3.39	16,466	15,322	89
	224	619	3.81	1,368	8.42	585	3.60	16,253	15,791	-101
7	244	305	3.16	824	8.53	342	3.53	9,666	8,448	63
	241	408	3.97	876	8.53	374	3.64	10,268	10,225	88
8	247	478	3.85	1,088	8.74	457	3.67	12,440	12,152	83
	245	411	3.99	879	8.53	362	3.51	10,314	10,293	81
Total for high-level grain feeding		3,732		8,879		3,700		105,227	98,065	773
Avg/cow		466.4	3.55	1,109.8	8.44	462.5	3.52	13,153	12,258	97
Avg/cow/day		1.28		3.05		1.27		36.1	33.7	0.26
Total for controlled grain feeding		3,687		8,341		3,571		101,469	95,897	1,097
Avg/cow		460.9	3.63	1,042.67	8.22	446.33	3.52	12,684	11,987	137
Avg/cow/day		1.27		2.86		1.23		34.8	32.9	0.38

^aFirst cow in each pair is on high-level grain feeding.

Table 10. A comparison of feed consumption and feed cost for 16 Holstein cows on high-level and controlled grain feeding for 364 days. (1964-65)

Pair no.	Cow no. ^o	Silage	Hay	Grain	TDN	Bone meal	Cost of feed	Feed cost per 100 lb. 4% milk
		lb.	lb.	lb.	lb.	lb.		
1	48	13,519	3,382	9,324	11,222	104	\$389.37	\$2.73
	134	13,487	6,492	3,046	7,813	104	239.74	2.26
2	205	13,019	3,555	8,196	10,328	104	355.41	2.71
	182	13,545	6,657	3,116	7,951	104	244.17	2.28
3	194	12,073	3,481	8,991	10,776	104	374.07	3.28
	196	13,047	5,829	2,986	7,360	104	227.66	1.97
4	225	13,233	3,526	8,299	10,429	104	359.09	2.97
	221	13,922	8,317	4,018	9,556	104	293.67	1.95
5	250	13,217	3,276	8,050	10,110	104	348.41	3.33
	241	13,991	6,594	3,076	7,966	104	244.17	2.13
6	262	11,900	3,334	7,431	9,439	104	324.66	2.95
	252	13,473	5,479	2,044	6,505	104	196.95	2.53
7	267	13,223	3,070	6,550	8,812	104	300.90	2.60
	266	13,011	5,646	2,209	6,653	104	201.93	2.57
8	270	9,186	2,947	6,585	8,148	104	282.22	2.40
	269	13,199	5,401	2,424	6,731	104	206.15	1.96
Total for high-level grain feeding		99,370	265.71	63,426	79,264	832	2,734.13	2.86
Avg/cow		12,421.2	33.21	7,928	9,908	104	341.77	
Avg/cow/day		34.1	9.1	21.8	27.2	0.29	0.94	
Total for controlled grain feeding		107,675	50,415	22,919	60,535	832	1,854.44	2.17
Avg/cow		13,459	6,301	2,865	7,567	104	231.81	
Avg/cow/day		37.0	17.3	7.9	20.8	0.29	0.64	

^oFirst cow in each pair is on high-level grain feeding.

Table 11. A comparison of milk, butterfat, solids-not-fat and protein produced by 16 Holstein cows on high-level and controlled grain feeding for 364 days. (1964-65)

Pair no.	Cow no. ^a	Butterfat		Solids-not-fat		Protein		4% Milk	Total Milk	Gain body wt.
		lb.	%	lb.	%	lb.	%	lb.	lb.	lb.
1	48	528	3.33	1,323	8.34	591	3.72	14,264	15,864	260
	134	369	3.11	1,016	8.33	406	3.33	10,569	12,197	-9
2	205	490	3.39	1,263	8.73	477	3.30	13,128	14,462	44
	182	388	3.19	958	7.88	390	3.20	10,691	12,162	-38
3	194	407	3.06	1,079	8.12	447	3.36	11,417	13,284	452
	196	405	2.96	1,140	8.35	493	3.61	11,528	13,648	0
4	275	456	3.46	1,073	8.14	454	3.45	12,110	13,183	347
	221	589	3.78	1,357	8.69	587	3.76	15,091	15,617	87
5	250	445	4.72	846	8.98	368	3.91	10,450	9,426	132
	241	458	4.00	989	8.64	392	3.42	11,449	11,449	70
6	262	438	3.96	968	8.75	439	3.97	10,995	11,065	-62
	252	291	3.40	719	8.40	292	3.42	7,790	8,554	156
7	267	438	3.50	1,085	8.66	426	3.40	11,588	12,531	133
	266	281	3.10	735	8.10	302	3.33	7,854	9,080	396
8	270	450	3.59	1,069	8.54	401	3.20	11,754	12,527	141
	269	392	3.39	985	8.51	388	3.36	10,518	11,577	36
Total for high-level grain feeding		3,652	3.57	8,706	8.51	3,603	3.52	95,706	102,342	1,447
Avg/cow		456.5		1,088.25		450.38		11,963.25	12,792.7	181
Avg/cow/day		1.23		2.99		1.24		32.87	35.14	0.50
Total for controlled grain feeding		3,185	3.38	7,899	8.38	3,250	3.45	85,490	94,284	698
Avg/cow		398		987.39		406.25		10,686.3	11,785.5	87
Avg/cow/day		1		2.71		1.11		29.36	32.10	0.24

^aFirst cow in each pair is on high-level grain feeding.

Table 12. A comparison of feed consumption and feed cost for 16 Holstein cows on high-level and controlled grain feeding for 364 days. (1965-66)

Pair no.	Cow no. ^a	Silage	Hay	Grain	TDN	Bone meal	Urea	Cost of feed	Feed cost per 100 lb. 4% milk
		lb.	lb.	lb.	lb.	lb.	lb.		
1	247	13,437	1,690	8,065	9,006	104	109	\$330.20	\$2.99
	241	14,224	6,306	3,440	7,936	104	109	252.67	2.13
2	205	12,752	1,713	8,387	9,157	104	109	337.05	2.74
	225	11,743	5,698	1,870	6,066	104	109	186.82	2.66
3	289	13,518	1,441	7,861	8,740	104	109	321.35	2.77
	286	14,114	4,176	3,190	6,668	104	109	218.06	2.14
4	196	13,336	1,678	6,831	8,054	104	109	292.58	4.29
	194	13,616	5,697	2,385	6,743	104	109	210.67	3.02
5	288	14,324	1,618	10,303	10,802	104	109	400.42	3.20
	287	14,058	4,574	3,600	7,166	104	109	235.07	1.92
6	132	13,548	1,704	8,375	9,268	104	109	340.15	2.48
	134	14,030	5,960	3,080	7,464	104	109	236.70	1.93
7	269	13,939	1,572	8,513	9,364	104	109	344.43	2.75
	267	14,249	6,054	3,505	7,862	104	109	251.60	1.98
8	290	13,439	1,671	8,450	9,290	104	109	341.52	2.46
	285	13,940	4,760	2,403	6,338	104	109	201.00	2.19
Total for high-level grain feeding		108,293	13,087	66,785	73,681	832	872	2,707.70	2.87
Avg/cow		13,536.6	1,635.9	8,348.1	9,210.1	104	109	338.46	
Avg/cow/day		37.2	4.5	22.9	25.3	.29	.30	.929	
Total for controlled grain feeding		109,974	43,225	23,473	56,243	832	872	1,792.59	2.17
Avg/cow		13,746.8	5,403.1	2,934.1	7,030.4	104	109	224.07	
Avg/cow/day		37.8	14.8	8.1	24.1	.29	.30	.616	

^aFirst cow in each pair is on high-level grain feeding.

Table 13. A comparison of milk, butterfat, solids-not-fat and protein produced by 16 Holstein cows on high-level grain feeding and controlled-level grain feeding for 364 days. (1965-66)

Pair no.	Cow no. ^a	Butterfat		Solids-not-fat		Protein		4% Milk	Total milk	Gain body wt.
		lb.	%	lb.	%	lb.	%	lb.	lb.	lb.
1	247	452	4.25	923	8.64	407	3.81	11,060	10,681	40
	241	480	4.13	1,011	8.69	466	4.00	11,861	11,640	191
2	205	497	4.09	1,050	8.65	451	3.71	12,310	12,138	-30
	225	257	3.23	624	7.85	252	3.17	7,028	7,950	-21
3	289	477	4.27	1,026	9.18	472	4.23	11,618	11,165	300
	286	427	4.50	845	8.90	319	3.36	10,191	9,484	189
4	196	238	2.93	657	8.10	289	3.56	6,815	8,114	456
	194	250	3.10	641	7.96	266	3.30	6,968	8,052	51
5	288	503	4.06	1,067	8.60	457	3.69	12,508	12,398	550
	287	482	3.85	1,065	8.50	427	3.40	12,251	12,535	119
6	132	494	3.14	1,221	7.76	475	3.02	13,713	15,747	-62
	134	467	3.48	1,105	8.24	443	3.30	12,366	13,421	191
7	269	467	3.37	1,164	8.40	480	3.47	12,542	13,848	117
	267	481	3.78	1,145	8.35	476	3.47	12,700	13,719	171
8	290	566	4.17	1,176	8.67	493	3.63	13,907	13,556	375
	285	345	3.43	835	8.32	363	3.62	9,182	10,034	41
Total for high-level grain feeding		3,694	3.78	8,284	8.48	3,524	3.61	94,473	97,647	1,746
Avg/cow		461.75		1,035.5		440.5		11,809.1	12,205.9	218.3
Avg/cow/day		1.24		2.84		1.21		32.4	33.5	.60
Total for controlled grain feeding		3,189	3.67	7,271	8.37	3,012	3.47	82,547	86,835	932
Avg/cow		398.6		908.9		376.5		10,318.4	10,854.4	116.5
Avg/cow/day		1.09		2.50		1.03		28.3	29.8	.32

^aFirst cow in each pair is on high-level grain feeding.

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