

1972

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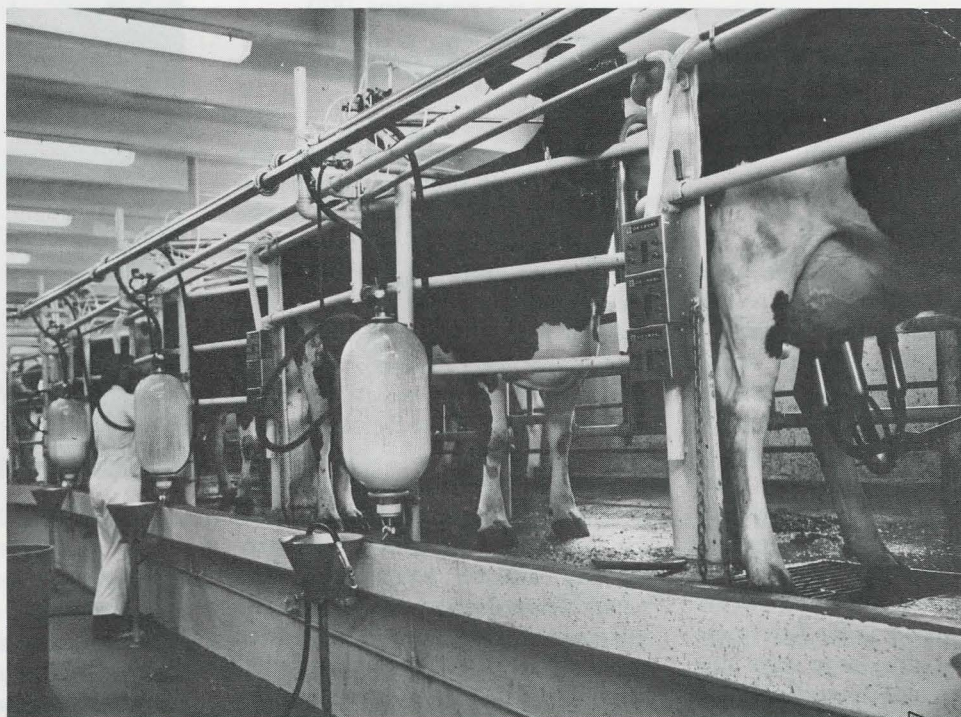
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EC 72-220



# 1971 DAIRY REPORT

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### Prepared by the staff in Animal Science and cooperating Departments for use in the Extension and Teaching programs

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# Will High-Producing Cows Fit Into Tomorrow's Production Systems?

Nathan E. Smith  
Department of Animal Science  
Cornell University

Average milk production per cow has been skyrocketing in recent years. Along with this increased average production we find more and more cows producing in excess of 20,000 or 30,000 pounds of milk per lactation. At the same time, average herd size has been increasing and the need for mechanization of dairy operations and group handling and feeding of dairy cows has become acute. Efficient use of labor and equipment by dairymen has dictated a swing away from the traditional method of handling and feeding each cow individually. These factors pose several questions.

In the first place, should we be striving to breed, feed and manage cows for these extremely high levels of production? Are special feeding and management practices required to maintain these cows? Are high-producing cows more susceptible to problems related to such things as reproduction, off-feed, displaced abomasum and other disease and health disorders? How much feed do these cows consume and how

do we get enough nutrients into them to meet their requirements? Can we do this and still have the feeding regime of the high-producing cow fit into the over-all herd feeding program?

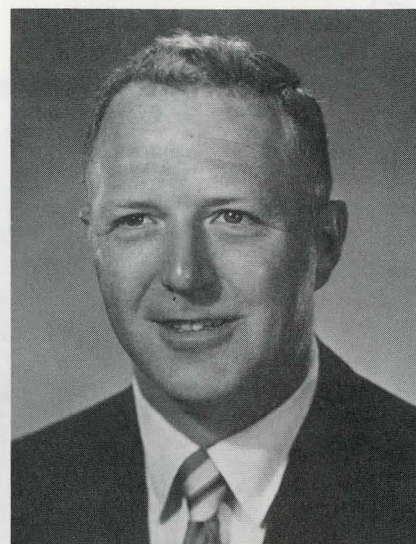
Even if the "Super" cow will fit into dairy production systems of the future, there are other basic questions that must be asked. Are high producers more efficient in converting feed into milk and thus potentially more profitable? How far can we go with increased production and/or efficiency? What basic physiological characteristics allow some cows to produce two or three times as much milk as other cows under the same management and feeding conditions?

## Answers Needed

Answers to these questions are needed if we hope to design the most effective dairy feeding, breeding and management systems of the future. However, these "answers" aren't easy to come by. There just hasn't been much research work done with cows at these high levels of production.

A project, directed at gaining some insight into these questions, was started on the Davis campus of the University of California through the cooperative efforts of California dairymen and university personnel. The project is still in progress and the purpose of this paper is to report some of the preliminary information gathered to date.

Cows with production potential of 20,000 to 30,000 pounds milk per lactation were purchased from dairymen and transported to research facilities on campus where they were placed on trial along with cows of lower production ability. Thus cows with production potential ranging from under 10,000 to over 30,000 pounds milk per 305-day lactation have been used



NATHAN E. SMITH

Dr. Smith operated the home dairy farm, consisting of 70 cows and 325 acres of cropland, after graduation from the Avon, New York, high school in 1953. The dairy was dispersed in 1963 and Nathan enrolled in the College of Agriculture at Cornell University. He graduated 3½ years later with Distinction, ranking in the top 5% of his class.

He continued his studies at the University of California at Davis. His thesis research dealt with the regulatory mechanisms that cause or prevent a depression of fat test in milk.

Dr. Smith joined the staff of the Animal Science Department at Cornell University in July 1971. His time is divided between extension and research with emphasis on feeding systems, complete feeds, group feeding and least-cost rations.

on the project. They are housed in individual pens containing an exercise yard and free-stalls for resting and eating, thus simulating commercial conditions.

The cows are milked twice daily and the milk is sampled and analyzed for fat and solids-not-fat content. All cows are weighed daily immediately following the morning milking. Breeding is delayed until the first estrus following 80 days after calving to allow each cow the

Table 1. Composition of Diet

Item	Composition of:	
	Mix	Concentrate
	(% DM)	(%)
Alfalfa hay	40	
Concentrate:	60	
Barley		87
Cottonseed meal		7
Tallow		4
Salt		1
Dicalcium phosphate		1
Crude protein	18.9	
Crude fiber	15.2	
Ether extract	5.2	
TDN	76.5	



potential of completing a 10-month lactation.

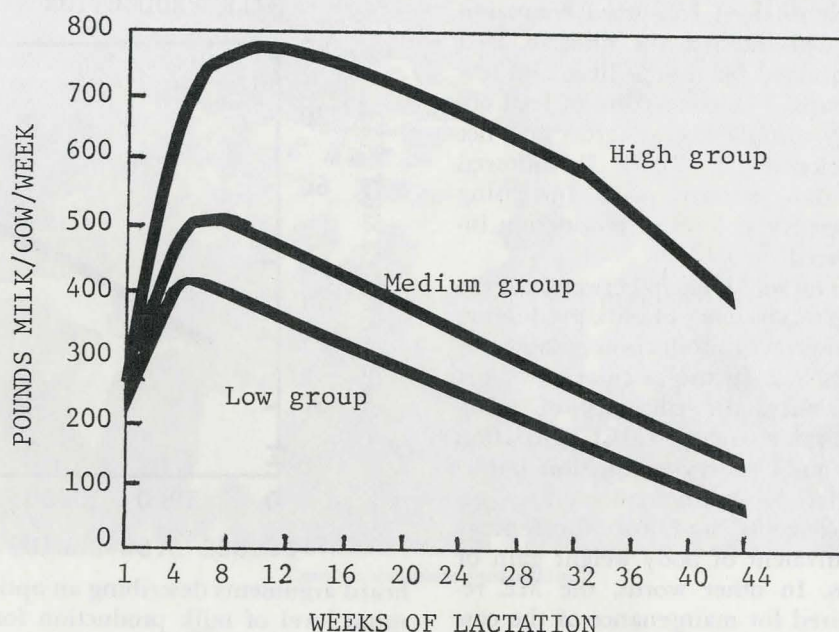
The cows are fed twice daily and daily intakes are recorded. The feed is a high-energy mixed ration consisting of 40% alfalfa hay and 60% of a concentrate mix. The compositions of the concentrate and of the mixed ration are shown in *Table 1*. The alfalfa hay is coarse ground and blended with concentrate. The mixed ration has been fed to the cows in meal form. All cows, regardless of production level, received the same mixed ration throughout the lactation and during the dry period. No additional feed was offered to the cows in the milking parlor.

### Three Groups

For purposes of preliminary analysis data the cows were divided into three groups based on actual 44-week (308 days) milk production: low—less than 12,500 lbs.; medium—12,500 to 17,500 lbs.; and high—greater than 17,500 lbs. Thus far, data has been collected from 46 lactations with 15 lactations in the low group, 22 in the medium group and 9 in the high group. The results reported herein pertain to cows fed the mixed ration free-choice throughout lactation.

Milk production, feed intake and body weight characteristics of these cows are presented in *Table 2*. Average milk production (308 days) for the high, medium and low groups was 24,241; 15,310 and 10,045 pounds, respectively. The highest level of production attained by an individual cow was 30,676 pounds milk in 308 days. Average milk production per cow per week is plotted against week of lactation in *Figure 1*.

Fig. 1. MILK PRODUCTION OF AD LIBITUM FED COWS



Peak milk production (average for the groups) was 111 lbs./day, 74 lbs./day and 61 lbs./day for the high, medium and low groups. These production peaks were reached at six to eight weeks following calving, regardless of level of production. However, note that as level of production increased there was a tendency to hold at or near peak production longer. In other words, higher producers appear to be more persistent producers.

Feed dry matter (DM) intakes also increased as level of milk production increased (*Table 2*). Average daily DM intakes (for the entire lactation) for the high, medium and low groups were 3.13 lbs./cwt. (100 lbs. body weight); 2.45 lbs./cwt. and 2.24 lbs./cwt. Maximum DM intakes occurred at 13 to 14 weeks after calving in all groups. Feed intakes at this time

were 3.75, 2.95 and 2.78 lbs. DM/cwt./day for the high, medium and low groups, respectively.

Thus, maximum feed intake occurred six to eight weeks after peak milk production (i.e., when nutrient requirements were maximum). Patterns of feed intake were similar to those for milk production with the higher producers maintaining intakes at or near maximum longer than the lower producers.

### Weight Gains

Average body weight was similar for all three groups of cows. Body weight gains, expressed as the difference between the average of the second and third weeks and the end of the lactation, were also very similar for all three groups. This is quite surprising, since it has been considered that low-producing cows will tend to overeat, gain excess weight and become overly fat if fed a high-energy ration free-choice over the entire lactation. These results indicate that lactating cows will regulate their intake according to requirements when fed a complete, mixed ration.

Although the high producers consumed more feed, they were also more efficient in converting feed to milk (*Table 3*). The high group of cows produced 1.88 lbs. milk for

(continued on next page)

Table 2. Performance of Ad Libitum Fed Cows<sup>1</sup>

Production group	Production		Feed dry matter intake		Body <sup>2</sup> weight	Lb. change <sup>3</sup> in body weight
	Lb. milk	Lb. fat	Total (lb.)	Lb./100 lb. body wt. per day		
High	24,241	706	12,896	3.13	1,434	+106
Medium	15,310	455	10,256	2.45	1,446	+74
Low	10,054	320	8,708	2.24	1,391	+130

<sup>1</sup> Lactations up to and including 44 weeks in length.

<sup>2</sup> Average of second and third week after calving.

<sup>3</sup> Change from second and third week after calving to the end of lactation.



(continued from page 3)

each lb. feed consumed compared to 1.49 and 1.16 lbs. milk/lb. feed consumed for the medium and low groups. The conversion of feed energy to milk energy (gross and net efficiencies in Table 3) followed similar patterns with increasing efficiency as level of production increased.

The relationship between net energetic efficiency of milk production and level of production is shown in Figure 2. In the calculation of net efficiency, the efficiency of metabolizable energy (ME) utilization for milk energy production is corrected for maintenance energy requirements and for the energy equivalent of body weight gain or loss. In other words, the ME required for maintenance of the cow and either the ME used for body weight gain or the ME equivalent required to replace body weight loss are subtracted from total ME intake. The net efficiency of milk production is then calculated from the ME intake above these requirements.

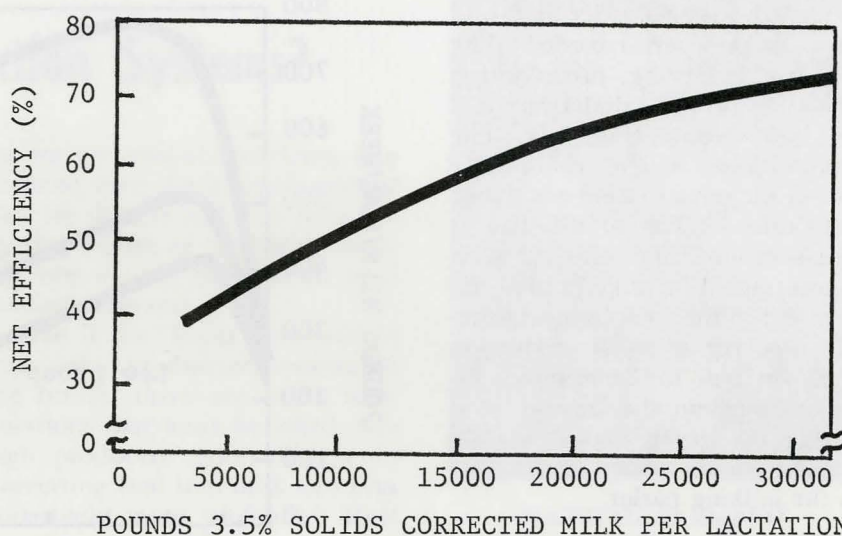
Although net efficiency increased with level of production, data analyzed thus far indicate that the relationship is curvilinear (Figure 2). This means that the increment in net efficiency decreases with each added increment in production. For example, the increase in net efficiency when production is increased from 5,000 to 10,000 pounds is about 9% whereas the net efficiency increases only about 5% when production is increased from 20,000 to 25,000 pounds (the same increase in production).

### Still Increasing

Even though net efficiency increases at a declining rate as we move up the production scale, the efficiency of milk production is still increasing. In other words, other factors being equal, breeding and feeding dairy cattle for higher levels of milk production will result in greater efficiency in converting feed to milk—at least up to a certain point.

Where is this point? We have all

Fig. 2. RELATIONSHIP OF NET ENERGETIC EFFICIENCY OF MILK PRODUCTION TO THE LEVEL OF MILK PRODUCTION



heard arguments describing an optimum level of milk production for greatest efficiency. It is interesting to conjecture where this point might be for the cows in this study. If the curve in Figure 2 is extrapolated, maximum net efficiency would occur at approximately 39,000 to 40,000 pounds of solids-corrected milk. In other words, this is the point where further increases in milk production would result in no further increases in net efficiency of producing milk from feed. If we assume that this group of cows is similar to the population of dairy cattle as a whole, it means we have quite a bit of room left for improvement before this maximum is reached.

Most State DHIA averages for Holsteins are between 12,000 and 14,000 lb. milk per year and seldom do we find herd averages much over 20,000 lbs. milk per year. In fact, it is of interest that 39,000 to 40,000 pounds of solids-corrected milk is

about the maximum level of production that has been attained by any cow to date, and there have been very few cows that have even approached this level.

One of the objectives of the project, in addition to the nutritional aspects, was to gather information related to health and disease problems that might be associated with extremely high levels of production.

Displaced abomasum (twisting or torsion of the fourth stomach) has been a major problem encountered thus far on the project. There have been 12 cases requiring surgical correction; 9 of these occurred within the first 2 weeks after calving. It would seem that this problem is primarily related to stresses associated with calving and possibly to diet rather than level of milk production since four of the cases occurred within each production group of cows.

The number of cows and of breedings is too small to draw conclusions regarding effects of level of production on breeding efficiency. However, reproductive efficiency up to this point has appeared to be similar for the three groups of cows.

What do these results mean to dairymen in terms of breeding for, and the feeding and management of, high-producing cows in the future?

Table 3. Efficiency of Milk Production<sup>1</sup>

Production Group	Lb. milk	Lb. milk/lb. feed	Energy Efficiency (%)	
			Gross <sup>2</sup>	Net <sup>3</sup>
High	24,241	1.88	42.1	61.3
Medium	15,310	1.49	33.9	55.5
Low	10,054	1.16	26.7	48.8

<sup>1</sup> Calculated for the entire lactation.

<sup>2</sup> Energy output in milk/metabolizable energy intake. ME intake is calculated from feed analysis.

<sup>3</sup> Gross efficiency corrected for maintenance requirement and for body weight gain or loss.



1. They are taking the right approach when they breed, feed and manage cows for maximum milk production. Higher producers are more efficient than lower producers and it appears there is quite a way to go before maximum efficiency is reached. There also appear to be no more general health problems with high producers than with lower producers.
2. Extremely high levels of production can be attained with fairly simple feeds (few ingredients) and feeding programs if the cow is fed a high energy feed that also meets other nutrient requirements, and if the cow has the genetic production potential.
3. They may be able to feed for extremely high levels of production with complete mixed feeds under group feeding systems and let lower producing cows within the group vary their own intake according to their individual requirements.
4. In other words, it looks as though the high-producing cow will fit into tomorrow's mechanized, group handling dairy production systems.
5. However, the problems encountered in this project indicate that much more is to be learned before we have all of the answers to problems associated with managing and feeding cows for high levels of milk production. This is particularly true with regard to the development of easily handled, mixed rations that will support normal digestive processes and animal function.

We have gained some insight into some of the questions asked about high-producing cows, but we have only scratched the surface. Research of factors related to feeding and managing high-producing cows should be of prime concern in future dairy cattle research. Such information is sorely needed if we are to design and implement effective and efficient dairy production systems for the future.



Cows on complete feed ration.

## Corn Silage-Based Complete Feed Experiment

### Progress Report No. 1

by

R. D. Appleman and F. G. Owen  
Professors of Animal Science

Can corn silage as the only roughage in a complete feed ration be successfully fed to dairy cows for three consecutive lactations? The University of Nebraska Animal Science Department is evaluating this ration, with and with-

out supplemental pelleted dehydrated alfalfa (DEHY).

Three rations are being evaluated. Ration 1 contains soybean oil meal as its source of supplemental protein. Ration 2 contains 10% DEHY and a limited amount of soybean oil meal. Ration 3 contains 10% DEHY plus supplemental urea and no soybean oil meal. The concentrate mix is mostly sorghum grain and a mineral-vitamin mixture, balanced for energy (59 mc cal/cwt.), protein (13%), calcium (0.6%) and phosphorus (0.4%). (Table 1).

#### Why This Experiment Is Being Conducted

1. Recent trends in feeding milk cows are toward more mechanization and the feeding of complete rations. Corn silage is a logical choice of roughage because of its high nutrient yield per acre and its uniformly high nutritional quality.

2. Corn silage is much lower than alfalfa in content of many min-

(continued on page 6)

Table 1. Ration Composition

Dry Matter Composition	Ration		
	1	2	3
Forage			
Corn silage	55.00	45.00	45.00
Grain mix			
DEHY (17% protein)	.....	10.00	10.00
Urea (281% protein)	.....	.....	1.35
Soybean meal (44% protein)	13.20	10.50	.....
Sorghum grain	30.02	33.05	42.08
Dical. Phos.	.63	.60	.80
Limestone	.65	.35	.27
Salt, trace mineral	.50	.50	.50

(All rations contain the following I.U./Lb. of dry matter: Vit. A = 2,000; Vit. D = 3,000; Vit. E = 4,000)



(continued from page 5)

erals; thus, ration is more difficult to balance and many specialists recommend the inclusion of 6 to 8 lb. of alfalfa hay daily—resulting in a more complicated 2-forage system of feeding cows. In several recently completed experiments, feeding corn silage as the only forage for more than two years resulted in nutritional deficiencies or other unexplained disorders.

3. If alfalfa is required or desired as a second forage, adding DEHY to the grain ration would seem to be a very practical method. Alfalfa in this form can be readily handled in a mechanized feeding system.

4. DEHY pelleted in combination with urea has a considerable economic advantage when compared with DEHY-soybean or soybean only sources of protein. Short-term lactation trials utilizing a combined DEHY-urea pellet have produced outstanding results. Long-term feeding trials are needed.

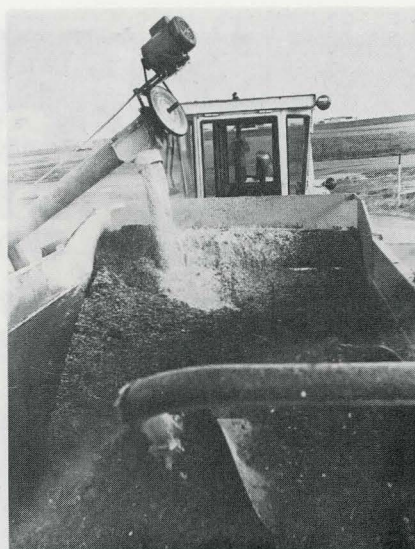
### Experimental Plan

Seventy-two Holstein cows will be placed on experiment immediately after calving. Assignment to one of three experimental groups is made eight weeks after freshening so that both "lactation number (age of cow)" and "production level" during the standardization period (3rd, 4th and 5th week after calving) are balanced as well as possible. It is hoped that at least 20 of the 24 cows assigned to each experimental group will remain through three complete lactations.

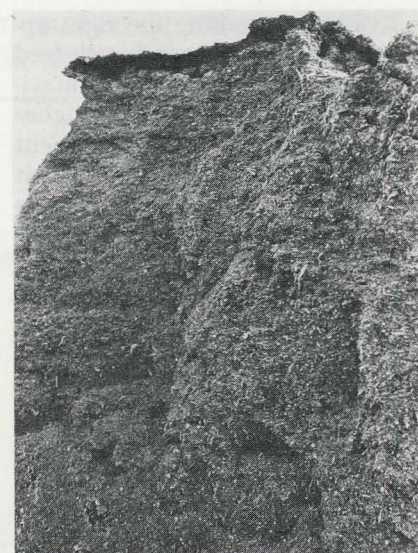
Cow response is being measured by recording differences in milk, fat and protein yields, voluntary feed intake, body weight changes and reproductive performance. Health data will include incidence and severity of various nutritional disorders, mastitis and other abnormalities. Economic analyses will also be made on production responses.

### Results to Date

As of January 1, 1972, 48 cows have been placed on experiment. Thirty of these, 10 in each group, have been fed experimental rations for at least six weeks. Fifteen of the



Grain mixture being added to corn silage in a mixer wagon equipped with an electronic scale.



Corn silage is stored in an above ground stack. Portion shown was covered with plastic; note the minimal amount of top spoilage.

first 30 animals are first-lactation heifers; 12 have freshened twice; and only 3 are in their third lactation.

Production during the three-week standardization period averaged 51.1 lb. milk daily with a fat content of 4.03%. Body weight at the end of this period averaged 1285 lb.

### Feed Intake

The feed consumed by each group is determined for a 24-hour period once weekly. Preliminary analyses of these data suggest considerable variation in day-to-day intake. This may be the result of several factors including: (a) periods of inclement weather, (b) changing social order of each group of cows because of the frequent addition of new cows, and (c) adap-

ting to the feed constituents, especially high urea.

Dry matter consumption during the first ten weeks for cows in groups 1, 2 and 3 averaged 3.89, 3.93 and 3.66 lb. daily for each 100 lb. of body weight, respectively. Even though the urea containing ration group has consumed less feed to date, it is too early to conclude that group 3 intake will be lowered significantly.

Consumption by all three groups is considered to be excellent. For example, the 3.89 lb. D.M. consumption observed in group 1, when applied to a 1300 lb. cow, amounts to the following: 92.7 lb. corn silage and 25.3 lb. grain mix.

### Body Weight

Body weights are obtained the day

Table 2. Average Daily Milk Production

	Group		
	1	2	3
4% FCM			
23-Day standardization period (lb.)	51.8	51.9	49.8
60-Day experimental period (lb.)	48.8	48.7	43.6
Change (%)	-5.9	-6.1	-12.4
Milk			
23-Day standardization period (lb.)	51.7	50.5	50.3
60-Day experimental period (lb.)	50.6	47.5	43.1
Change (%)	-2.1	-5.9	-14.4
Fat Test			
23-Day standardization period (%)	4.00	4.18	3.94
60-Day experimental period (%)	3.74	4.24	4.09
Change (percentage units)	-26	+ .06	+ .15



following freshening, at the end of the standardization period, and at monthly intervals, thereafter. From freshening to the end of the standardization period (average of 37 days), the first 30 animals on trial had an average weight loss of 42 lb. After assignment to treatment groups 1, 2, or 3, these same animals gained back an average of 61, 45 and 12 lb., respectively. Weight changes seem to correspond well with their respective feed intake measurements.

### Milk Production

During the early weeks of this experiment, persistency of milk produced by groups 1 and 2 have averaged about 94% of their standardization period production. Group 3 cows, on the other hand, have produced FCM at only 88% of their previous level (table 2).

Group 1 cows showed a decrease in daily milk of only 2.1% with a not unexpected drop in fat test of 0.26%. The inclusion of DEHY in ration 2 resulted in a 5.9% drop in production, but the 4.2% fat test was maintained. The inclusion of urea in combination with DEHY, and with no supplemental soybean meal (ration 3), shows a 14.4% decrease in milk yield, but with a corresponding increase in fat test of 0.15%.

The experiment is still in its early stages and results have not been analyzed for statistical significance. It should be kept in mind that current trends in production may or may not continue. One factor to consider is that, at this time, only ten cows are involved in each group. A second consideration is that in the case of ration 3, adaptation may take longer than for other rations.

### Health and Reproduction

No attempt has been made to analyze the health and breeding data at this time. Although there have been at least two cases of severe mastitis, most cows appear to be producing normally and none have exhibited unusual reactions to any of the treatments.

# Feedlot Waste Management For Dairy Farms

Philip H. Cole

Extension Dairyman

Dairymen along with all other livestock producers are faced with an important deadline. Between now and December 31, 1972, all dairymen, regardless of size or type of operation, will be expected to take whatever steps are necessary to get in compliance with Nebraska's runoff control regulations.

### The Law

The Nebraska Water Pollution Act states that it is unlawful for any livestock producer to discharge livestock wastes into Nebraska's waters or onto a neighbor's property. This law is implemented and enforced by the 16 member council of the Nebraska Department of Environmental Control. All Nebraska livestock producers are required to satisfy the state law of NO DISCHARGE, regardless of livestock numbers, by December 31, 1972.

Specifically, the law states that there will be no livestock wastes run off your farm onto a neighbor's land or into an adjacent road ditch.

### Procedure to Follow

The step-by-step procedure that a dairyman should follow, along with the costs is outlined below:

Step	Cost to Producer
1. Producer inquire at Extension or SCS office for information and receive E.C. 71-795 and Data Sheet WP-41.	None
2. Producer complete Section I of Data Sheet and make date for SCS to visit feedlot.	None
3. SCS will visit feedlot for survey and do either of two things:	
a. Complete Section II, part A and B of WP-41	

stating no control facilities needed. None

b. Complete all of Section II of WP-41 with practical control measures included. None

4. In both cases above, the producer sends plan to Nebraska Department of Environmental Control for approval and automatic registration (other copies distributed as indicated on page 4 of WP-41). 8¢ postage

5. Producer visits contractor for a cost estimate of the control structures. None

6. Producer checks with ASCS on cost share (REAP funds) possibilities. None

7. Upon approval from Department of Environmental Control construction can begin. None

### Technical Assistance—Who Qualifies

If your feedlot is less than 10 acres in size, you automatically qualify for free technical assistance from the Soil Conservation Service (SCS). If your feedlot exceeds 10 acres you should contact a consulting engineer. If no consulting engineer is available, you should contact your local SCS stating such. The local SCS will be permitted to work on your feedlot upon approval by the state SCS, and if time is available.

If you hire a consulting engineer to do the job, his plan must meet SCS design standards and be approved by The Department of Environmental Control if you wish to qualify for cost-sharing through ASCS.

### Cost-Sharing—Who Qualifies

If you qualify under the ASCS program, you are eligible for cost-sharing funds under the Rural Environmental Assistance Program

(continued on page 8)





Feedlots under 10 acres in size are eligible for free technical assistance from ASCS.

(continued from page 7)

(REAP) which would pay part of your construction costs for your runoff control plan.

Depending on the type of construction needed, cost-sharing is available in most counties on a 50 to 80 percent basis, up to \$2,500.

### Approval Required

It is important to remember that all runoff control plans whether designed by the SCS or a private consulting engineer must be approved by the State Department of Environmental Control *before* construction is started.

### A Typical Facility

A typical waste management facility usually has certain essential features. These include: (1) a diversion terrace, (2) a debris basin (settling basin), (3) a holding pond, and (4) a means for spreading wastes on cropland.

(1) The *diversion terrace* located above the feedlot, keeps outside drainage out of the lot. This reduces the potential waste runoff from the lot and also reduces the size and cost of the debris basin and holding pond.

(2) Lot runoff is first collected in

a *debris basin* located immediately below the lot or inside the lot if space is available. Solids carried in the runoff from the lot settle in the debris basin and must be removed once or twice a year when the basin is dry.

(3) The liquid runoff flows from the debris basin through a flow control device into a pipe to the *holding pond*. The holding pond must have the capacity to hold all runoff until it can be disposed of by spreading it on cropland.

### Management Factors to Consider

1. *Scraping Lots.* Research has



The law says feedlot operations of any size must prevent livestock wastes from leaving their land.



shown that lot runoff will be greatly reduced by allowing manure to accumulate on the lot rather than scraping (dirt resting areas out away from milking area). Scraping of lots down to the soil to remove manure is *not* recommended since this removes the manure cover that acts as a mulch to protect the soil from erosion. The manure also acts as a sponge to hold runoff to a minimum.

2. *Mounding.* When the manure gets too deep on the lot, it should be scraped into mounds to provide a place for animals to rest. Mounds should extend up to the feed bunk apron and should be placed up and down the slope to aid in lot drainage. Considerable composting and decomposition of animal waste takes place in a properly managed mound.

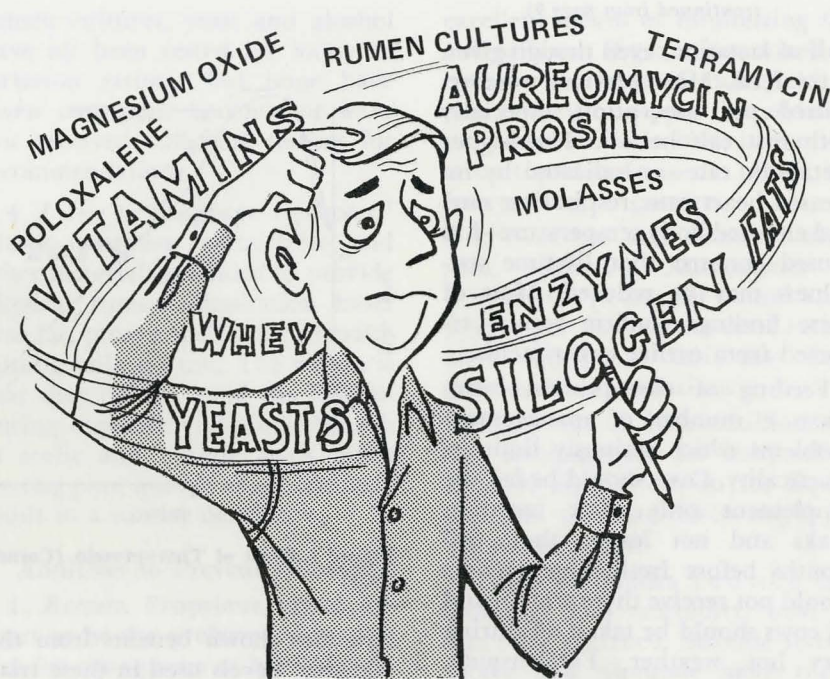
3. *Management.* Regardless of the system used careful management by the dairyman will determine the success of the control facility. Removal of solids from debris basins once or twice a year will be needed. Pumping of wastes from holding ponds for spreading on croplands will provide storage for runoff from the next rainfall.

### Summary

Not all dairy operations will require all of the features described above. On the other hand, some operations may require even more elaborate facilities.

The design of a facility for a particular dairy operation is an individual problem that must be planned for that particular operation. On some dairies a diversion ditch may be all that is needed. There are a number of dairies, because of their size and their location on the farm (no runoff into streams or onto neighboring farms) where no runoff facilities are needed.

The best procedure is to seek technical assistance and find out what is needed for your dairy operation. Competent assistance in the design of facilities is the first and most important step in controlling dairy waste successfully.



## FEED ADDITIVES

Foster G. Owen

Professor of Animal Science

Through the years dairymen, as well as dairy nutritionists, have searched eagerly for special feed additives to alleviate practically every production and health problem encountered in dairy herd operations.

In the process a few evolved which were both effective and practical. However, many were neither effective nor practical and were discarded. Unfortunately, many that were not discarded should have been.

Below is a discussion of the additives which offer special benefits to the ration. Others, though not generally recommendable have received considerable attention and deserve mention.

### Additives Affecting Lactation Performance

1. *Thyroprotein.* Increases in milk production of 10-25% are often reported in the period soon after introducing thyroprotein into the ration. In most cases milk fat content is also increased. To ob-

tain a lactation response about 25-30% additional grain is required.

It is recommended that this additive be introduced into the feed about 50-100 days following calving and that it be withdrawn 3-4 months before calving.

Unfortunately, the production response generally diminishes with advancing lactation and usually drops below the control animals after withdrawal of the additive. Therefore, total lactation yields may be improved very little, or not at all, compared to yields obtained from the extra grain alone.

Recently, Cornell reported results of a very thorough three-year study of thyroprotein in the ration of lactating cows. The additive was fed from the 50th day after freshening to two months before expected calving. Results are shown in Figure 1. Milk production increased from about the 10th to the 18th week then dropped below the production level of the control group.

Other problems were also associated with thyroprotein use. Cows lost more weight during the first

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half of lactation, even though given extra feed. More services were required per conception, especially with first calf heifers. The higher metabolic rate—as indicated by increased heart rate, respiration rate, and elevated body temperature—has caused concern that lifetime usefulness may be reduced. Most of these findings confirm results reported from earlier experiments.

Feeding of thyroprotein introduces a number of management problems which seriously limit its practicality. Cows should be fed the supplement only after lactation peaks and not longer than two months before freshening. Heifers should not receive thyroprotein and all cows should be taken off during very hot weather. Furthermore, thyroprotein cannot be fed to cows on DHIA or other official tests. For these many reasons we do not recommend this additive.

2. *Antibiotics.* Aureomycin and Terramycin are approved by the Food and Drug Administration for use in the rations of lactating cows. The approved level is .1 mg per lb body weight per day.

Although these antibiotics were accepted as preventatives of bacterial diarrhea and foot rot, these antibiotics have also increased milk yields in field trials by an average of .8-1.0 pound per cow daily. Benefits were greatest during winter months. Positive lactation responses, however, have not generally been obtained in university research herds.

Addition of an antibiotic to the herd rations would appear advisable only when certain infectious disease are a chronic problem.

3. *Methionine hydroxy analogue (M analog).* In 1968, workers at Pennsylvania State University reported a milk production increase from adding 40 or 80 gm of M analog to the daily ration. At the 80 gm level, palatability was a problem.

Short term trials at both Southern Illinois and Wisconsin

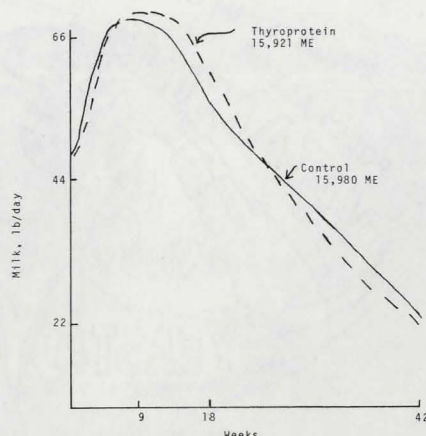


Figure 1. Effect of Thyroprotein. (Cornell, 1971)

have not shown benefits from this additive. Levels used in these trials ranged from 5 to 45 gm/day.

Missouri researchers fed 12 gm of M analog daily in a 120 day trial also without improving milk production.

Recent results from Virginia indicated that the level of M analog is very critical in obtaining lactation response.

A level of 25 gm per cow daily gave the best response in milk, whereas further increases continued to produce higher milk fat tests (Figure 2). At 80 gm, however, feed intake and milk yield were reduced.

The only university trials of longer than four weeks duration in which levels near the optimum were tested involved cows producing below the level at which methionine deficiency is thought to be limiting production. Therefore, results of field trials, involving large numbers of high producing cows is of special interest.

Table 1 shows a summary of the results of tests in three states

Table 1. Response to M Analog Field Trials (Chandler, 1971)

	Milk, lb.	Fat, lb.	FCM, lb.
Top Cows 16,000 lb.	+1,299	+70	+1,574
Bottom Cows	+ 392	+21	+ 464
Average	+ 845	+45	+1,019

(Georgia, Virginia and Delaware) involving 180 cows averaging 14,369 lb milk.

The reason why high producers respond best is thought to be due to the high need for methionine for milk synthesis and the inability of the rumen to synthesize the amount needed. In addition, it appears that methionine is involved in the normal movement of fatty compounds in the cow's blood system. This process is essential for efficient use of body fat reserves in the production of milk fat.

### Special Additives to Maintain Fat Test

Recent changes in feeds used and the level of grain feeding have tended to increase the problem of milk fat depression.

Such changes include: (a) feeding increased levels of grain along with the use of a large percentage of high-starch low-fiber ingredients such as corn and milo, (b) the pelleting or flaking of such feed ingredients, and (c) the use of high moisture grains.

What can additives do for the fat test problem? Several types of additives are helpful, but none appear to completely solve the problem in cases of severely low tests.

1. *Mineral additives.* Sodium bicarbonate at 1% of the ration along with 0.5% magnesium oxide is a recommended mixture. Sodium bicarbonate alone will usually help. The level should be 1 or 1.5% of the grain ration. Since bicarbonate is not palatable, it should not be included at levels over 2.0%.

Sodium bentonite, a colloidal clay, has been shown to improve test when added at 5% of the concentrate.

While feeding fat-depressing rations Wisconsin workers maintained milk fat at 80-90% of normal with each of these additives compared to the control ration which depressed the test to 35-60% of normal.

### 2. Nutrient additives.

A. Partially-delactosed whey. Rather extensive tests have proven



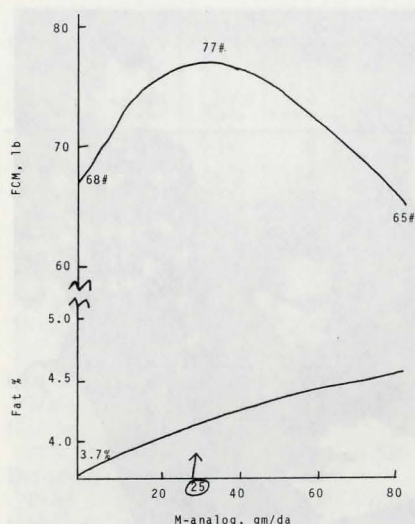


Figure 2. Lactation response to M-analog. (Chandler, 1971)

that this material will help maintain fat test when included at 10% of the grain ration. It has been tested under both university and field conditions. In addition to its value toward holding up fat test, it contains about 17% protein and has a high energy value.

**B. Fats.** Generally adding fats, especially unsaturated fats, in excess of 5-10% of the concentrate ration causes a reduction in milk fat content. However, adding 30% ground uncooked soybeans to rations of one-third or more roughage improves fat test. In contrast, adding this level of soybeans to rations of less than one-third roughage may depress fat test.

Limited information available indicates that cooked soybeans are equal to soybean meal as a protein source; whereas the extruded beans may be somewhat superior. Additional research is urgently needed to definitely establish the comparative value of these feed stuffs.

**C. Molasses.** It will have a slight fat test depressing effect in some rations.

**D. Salts of acetic acid.** Sodium acetate and ammonium acetate offer potential value as fat supportive additives, but more research is required as a basis for recommendation.

3. *Rumen "stimulants."* Enzymes,

rumen cultures, yeast and alcohol have all been tested for value in lactation rations, but none have given consistent benefits, or have not received sufficient testing for recommendations.

4. *Inert "roughage replacers."* Plastic particles, vermiculite and other materials intended to provide physical rumen stimulation have, thus far, proven ineffective in maintaining milk fat test. The reason is that they do not yield the fat-producing digestive end-products such as acetic and butyric acids. Even feeding poor quality roughages may result in a similar deficiency.

#### Additives to Prevent Disease

1. *Ketosis.* Propylene glycol appears to be the preferred preventative for cows prone to have ketosis. About 1/4-1/2 lb/day is needed. This is probably best administered by adding it to a small amount of the grain ration in two daily feedings. Results have been excellent with this additive.

Sodium propionate also is effective, but has the disadvantage of being unpalatable.

Methionine analog also has been beneficial in some studies, but not in others.

2. *Milk fever.* Including vitamin D in the ration at a level of 20 million units per day has proven a valuable preventative. Feeding should be started as nearly as possible to seven days before calving. Feed for at least five days, but not more than seven days. Since this material also is unpalatable, it may have to be mixed with molasses or with silage to get cows to consume the required amount.

Adding mineral supplements to adjust the calcium-to-phosphorus ratio to between 1:1 and 2:1 also appears helpful. Arizona workers added a high level of monosodium phosphate to an alfalfa hay-based ration and practically eliminated milk fever in a herd that had serious problems with this disease.

3. *Bloat.* Inclusion of Poloxalene in the grain ration of cows grazing high-legume pasture has been an

excellent means of minimizing the risk of bloat. If grain is rationed to cows on the basis of milk yield, it may be best to supply this additive on a more uniform basis in the lot, or on top of grain in the parlor, before turning to pasture.

4. *Foot rot and bacterial diarrhea.* Including Aureomycin or Terramycin (.1 mg per pound body weight per day) in the cows ration on a continuous basis may help prevent these conditions.

Either one of these antibiotics is also recommended for baby calves at 25-50 mg per day in the liquid diet and at about 10-15 mg/lb in the starter ration.

These antibiotics reduce calf mortality and morbidity, tend to minimize diarrhea, increase starter intake and stimulate more rapid gains.

#### Vitamin and Trace Mineral Supplements

In Nebraska we have no known problems related to trace-mineral deficiencies. However, we recommend using a reputable brand of trace-mineralized salt as a safeguard against possible deficiency.

With usual rations of green roughages our rations are seldom short of carotene (vitamin A); however, if more than half the forages being fed is badly weather damaged or underwent excessive heating after storage, then supplemental vitamin A should be included.

Vitamin D shortage is very unlikely in mature cows. The ration could require supplementation if cows are fed only direct-cut forages such as silages, and are kept in confinement so that exposure to sunlight is severely limited.

A field trial involving 114 dairymen in New York and Pennsylvania was conducted to evaluate a complex mineral-vitamin supplement over a two-year period. No benefits to milk yield, health or reproductive performance were found from supplementing rations of cows fed usual simple supplements.

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### Silage Additives

Among the relatively new additives which appear to offer important benefits to dairymen are urea and ProSil, a commercial product containing ammoniated molasses and minerals.

ProSil contains sufficient protein and minerals to make a balanced ration for non-lactating cattle or cows producing below 30-40 lb. of milk daily. It retains its protein value better under some conditions and maintains a higher level of milk production than does urea.

Such protein additives offer great potential for reducing ration cost.

Results at Nebraska suggest that certain enzyme additives may reduce losses and improve lactation performance. Additional tests are needed as a basis for recommendations.

Formic acid is effective in reducing losses and improving keeping quality of direct-cut hay-crop silages, however, benefits to lactation appear to be small in the trials conducted thus far.

### Recommendations and Conclusions

Nebraska dairymen should be alert to the possible benefits from using additives of proven value. They also need to be aware of those that have been proven ineffective and those that have not been tested.

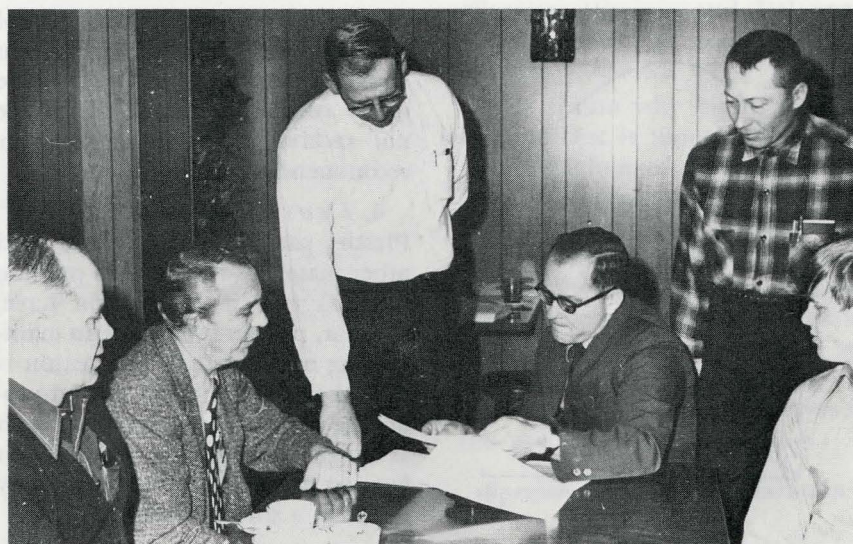
Antibiotics offer proven benefits in the calf's ration and in the ration of the lactating cow under certain conditions.

A methionine product (Methionine analog) appears to offer benefits to high-producing cows.

The dairyman may find additives helpful in maintaining milk fat tests and reducing the incidence of milk fever, ketosis and bloat.

When corn or sorghum silage is fed as a major part of the ration, addition of a non-protein nitrogen source such as urea should be considered as a means of reducing ration cost.

For details on the use of additives dairymen may contact their county agent or extension dairy specialists at the Department of Animal Science, University of Nebraska.



Kubik (with papers) discusses least cost feeds with (from left) Wayne D. Drew, Yutan; Gayle Hattan, Wahoo, Saunders County Extension Agent; Don Rood, Wahoo; Ed Sousek, Morse Bluff, and Carl Rood, Wahoo.

## Computer Formulated Least Cost Rations

Don J. Kubik

District Extension Dairyman  
Northeast Station

A true least cost ration is the combination of ingredients which, as the ration is computed, have the

Table 1. Suggested Composition for Complete Feeds For Lactating Cows

Estimated			
Net Energy	58-68 Therms	min.*	
Crude (Total)			
Protein	11.5-13%	min.*	
Crude Fiber	15-20%	min.*	
Calcium	0.4-1.0%	range	
Phosphorus	0.4-1.0%	range	
T. M. Salt	0.5%		
Urea	0.6-0.8%	max.*	
Vitamin D	3,000 I.U./lb.		
Vitamin A	2,400 I.U./lb.		
Hay Equivalent	35%	min.	

Figured on 90% Dry Matter Basis

\*Ranges accommodate rations of average and high energy levels.

lowest total costs and still assure optimum performance of dairy cows in terms of milk production, maintenance and growth.

The requirements for the ration must stay within the limits shown in Table 1.

In addition to the nutrient requirements shown in Table 1, certain feeds are restricted for dustiness and palatability in order that all rations will give equal performance.

To show the dollar savings possible with the least cost ration formulation, Table 2 compares the

Table 2. Ration Cost Comparisons

	13% Protein	16% Protein
Commercial	\$68.00/T.	\$71.00/T.
50% Corn, no urea	58.00/T.	64.00/T.
Least Cost	49.00/T.	53.00/T.

Table 3. Feed Grain Dollar Values Compared to Corn

	Unit Cost	Ton Cost	Value Per Ton	Value Compared to Corn
Corn	\$1.21/bu.	\$43.20	\$43.20	\$ 0.00
Oats	.70/bu.	43.80	43.77	- 0.03
Barley	1.04/bu.	43.40	48.70	+ 5.30
Rye	.90/bu.	33.20	43.49	+10.29
Hominy		63.60	46.32	-17.28
Milo	1.75/cwt.	35.00	44.89	+ 9.89
Wheat	1.39/bu.	52.20	49.49	- 2.71



Table 4. January 1972 Rations

	Least Cost	No Urea	No Sorghum	No Rye No Sorghum No Urea
Sorghum	53	48	0	0
Rye	33	33	33	0
Barley	0	0	48	58
Oats	0	0	0	26
Screenings	0	0	8	0
S. O. M.	10	14	2	14
Soybeans	0	2	5	0
Urea	.9	0	.9	0
	\$ 2.10	\$ 2.28	\$ 2.25	\$ 2.60
Cost/Ton				
Meal	\$42.00	\$46.00	\$45.00	\$52.00
Rolling				
Mixing	5.00	5.00	5.00	5.00
Delivered				
Price	\$47.00	\$51.00	\$50.00	\$57.00

Least cost = base. No urea = +\$4.00/T.  
No sorghum = +\$3.00/T. No rye,  
sorghum or urea = +\$10.00/T.  
Price also includes necessary vitamins and min-  
erals.

price of three different rations with quoted prices at two protein levels. These prices were quoted for pelleted and delivered rations at Wayne, Nebraska in August of 1971.

As you can see, the savings may amount to \$18.00-\$19.00 per ton, or \$40.00-\$50.00 per cow per year.

The primary reason for these savings has been the variation in grain prices. Look at Table 3 and see what a difference grains would have made in January 1972.

This shows that barley, rye and milo were more economical to feed in January 1972 than corn or oats, while wheat and hominy were more expensive to feed than corn or oats.

Using these prices least cost rations and rations with limitations placed on them were computed as shown in Table 4.

Although our discussion has been focused on the grain ration, the computer has the capacity to consider roughages also.

Local suppliers do not always have available all the grain which would make a ration the least cost. Dairyman in local areas will have to create a demand for certain grains when they are inexpensive. The elevator must have storage room available, plus enough volume to warrant handling the grain. In addition, the elevator or supplier must be able to buy the grain.

# Reproduction and Reproductive Problems

E. F. Ellington  
Associate Professor,  
Animal Physiology

There is probably no subject that holds more interest than does that of reproduction. The ability to reproduce is a fundamental characteristic of all living matter.

Reproduction may be so simple in lower forms, such as microscopic, single-celled organisms, as to involve a division of a cell with subsequent development of each half.

But in higher forms, such as cattle, reproduction is an extremely complicated process. Before it may be successful, a series of complex coordinated events must occur in both the male and female.

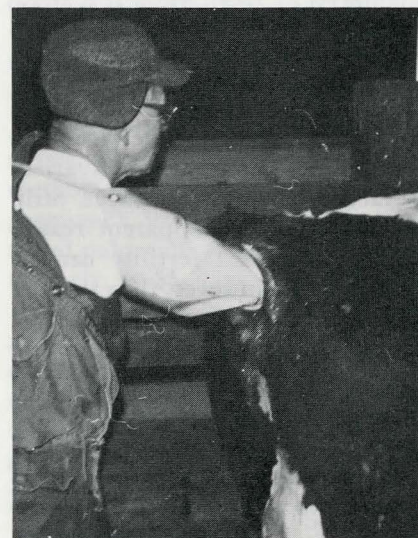
For example, the principal reproductive events in the male include the formation of the male germ cell (spermatozoa), sexual ex-

Only those feed grains, supplements and by-products which are available may be included by a dairyman for calculation. Grains on hand on the farm should be included at the price they could be sold off the farm for, not what they cost to buy back.

When the dairyman fills out a request form for a least cost ration formulation, he includes only those feeds which (1) he can obtain, and (2) those feeds which he would include in his ration. A good example of this is urea. If the dairyman wished to have a ration calculated without any urea he simply does not list a price for urea and then it will not be considered.

A good discussion on the mechanics of computer calculated least cost rations may be found in the 1969 Dairy Report, E. C. 70-220.

For more information, contact your local County Extension Agent. He has the necessary application blank.



Regular checks on health status and routine pregnancy diagnosis are very helpful in maintaining breeding efficiency.

pression, copulation and ejaculation.

The events occurring in the female are in total more complicated and consist of the development and release of the female germ cells (eggs or ova) from the ovaries, sexual expression or estrus, copulation, transport of ova and spermatozoa, fertilization, ovum implantation, pregnancy and parturition. Because of the close relationship between reproduction and lactation, lactation may be listed as a reproductive event in the female.

## Reproductive Disturbances

It is apparent that because a number of complex reproductive events must occur before reproduction can be possible, derangement from the normal necessary for reproduction may occur at many points. The alterations may be slight or they can occur to the extent that a complete loss of fertility (sterility) occurs.

The financial implications of any fertility decline are obvious, as the ultimate value of any farm animal depends on its ability to reproduce.

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The significance of reproduction cannot be over emphasized in dairying because not only is it important from the standpoint of production of replacements, but it is needed as an annual stimulus for milk production.

In some instances, a specific condition or disturbance may be the cause of a reproductive problem, whereas in other instances a variety of factors may be responsible. Still, in other cases, no apparent reason for the impaired fertility can be determined. However, the causes of most reproductive problems can be found among the following:

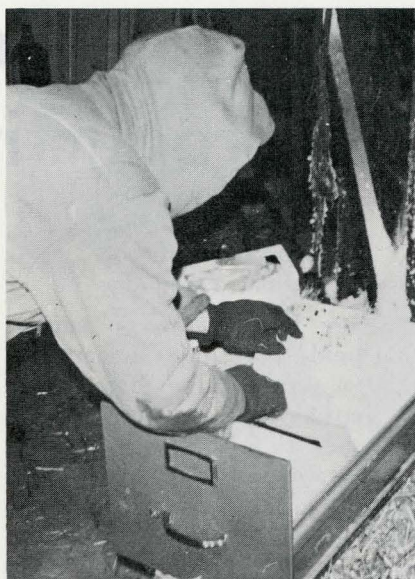
1. anatomical defects, such as a missing part of the reproductive tract;
2. mechanical injuries, such as uterine damage at the time of calving;
3. nutritional deficiencies, such as a vitamin A disturbance;
4. hormonal disturbances, such as an excess or deficiency of a particular hormone;
5. genetic causes, such as the expression of a lethal trait and a resulting pregnancy failure;
6. pathological disorders, such as vibriosis;
7. managerial problems, such as insemination at an incorrect time;
8. miscellaneous problems, such as elevated environmental temperatures and problems of unknown causes.

It is obvious from this list that a number of areas of study are involved in reproductive problems. The following discussion will deal initially with hormonal factors as they relate to reproductive problems in cattle and then with management methods to improve reproductive efficiency.

### Hormonal Significance

Growth, development and functioning of the reproductive systems of both the male and female are primarily under the influence of hormonal secretions.

Hormones are chemical substances that are released directly into circulation by glands located



Maintaining complete individual cow records helps both the dairyman and the veterinarian.

throughout the body and they typically travel to other parts of the body to regulate and coordinate activities. Some, such as the thyroid hormones, are involved indirectly in reproduction in that they maintain the animal in a state of general well-being, whereas others act directly and more specifically on reproductive structures.

The pituitary gland, ovaries, testicles and placenta are the major sources of hormones directly involved in reproductive processes. As possibilities of hormonal disturbances are almost endless, only examples of some of the more common abnormalities will be mentioned here.

### Development Disturbances

Failure of reproductive structures to develop (sexual infantilism) may be a cause of irregular or absent heat periods in females and lack of sex drive in males. Such animals usually become excessively fat and resemble steers or spayed heifers. This condition presumably is the result of decreased secretion of hormones called gonadotropins by the pituitary gland. Unfortunately, treatment with such hormones is not often successful.

Hormonal factors have been implicated as being responsible for the abnormalities in the reproduc-

tive system of the so-called freemartin. This condition is found when a heifer calf is born twin to a bull calf. In such cases, 11 out of 12 genetic females will have abnormal reproductive systems and be sterile. The male twin, of course, will be normal.

Since only a small percent of heifers born twin to a bull are fertile, saving them for breeding purposes offers much risk. However, even though such animals may be sterile, they still have value in terms of meat production.

### Corpus Luteum Problems

Abnormal function of a structure on the ovary called the corpus luteum can alter fertility. This structure has primary roles in regulating the estrous cycle and in maintaining pregnancy. A new one is formed after each heat and ovulation, but if the female does not become pregnant it loses its function before the next heat period.

If it should fail to lose its function, the cow will not come into heat nor ovulate, and this is what happens during normal pregnancy. But if it persists in the non-pregnant female (persistent corpus luteum), she will go into a prolonged period of sexual quiescence (anestrus) and not breed. Some evidence indicates that only a partial persistence of its function may result in a condition of ovulation without heat (silent heat or silent ovulation).

Aberrations in corpus luteum function have been implicated as being one factor involved in the hard-to-settle animal (repeat breeder). These individuals require two, three, or more services before they conceive. Failure of fertilization and high embryonic mortality have been observed in studies with repeat-breeding cows. Hormones from the corpus luteum, as well as from other structures, are important in both of these areas.

### Follicle and Other Problems

Abnormal function of another ovarian structure, the follicle, can interfere with reproduction. The follicles are the structures that con-



tain the developing ova and secrete some of the female sex hormones. Occasionally they continue to grow to enormous sizes rather than to rupture and release their eggs (ovulation). The enlarged follicles are called "ovarian cysts" and in cattle they often cause exaggerated sexual desire (nymphomania).

Breeding of such animals does not result in conception unless there is a recovery from this condition and ovulation occurs. One explanation for the development of ovarian cysts is based on a disturbance of the secretion of gonadotropic hormones by the pituitary gland.

Hormonal disturbances can be at least partly responsible for other alterations in the estrous cycle as well as for other reproductive problems such as difficult calving. No doubt, problems in the male such as deficient sexual desire and reduced semen quality are at times due to hormonal disturbances.

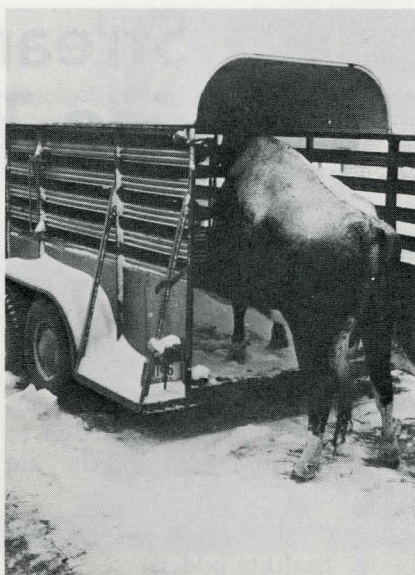
In spite of the important role of hormones in reproduction, it is well to keep in mind that not all reproductive problems are due to hormonal disturbances. A wide variety of hormonal preparations are available, but none should be used except under the direction of a well-informed practitioner.

### Management and Reproductive Problems

We are perhaps guilty of thinking that the cow herself is responsible for all reproductive problems because of some factor rendering her sexually defective. This, of course, is not always true. In many cases the problems are "man problems" or management problems rather than "cow problems," particularly where AI is practiced.

No doubt, sizable increases in profit are possible in many herds if more attention is given to careful management. The following is a list of some management points that need to be given careful consideration.

1. Breed heifers at the proper stage of development. Breeding too



The infertile cow going to the sales barn results in large financial losses.

early can result in poor conceptions and also calving difficulties if conception does occur. For example, it would be well to have Holstein heifers weighing 800 lb and Jerseys 600 lb at the time of first breeding.

2. Breed at the proper stage of the cycle. The cow is typically in estrus for 16-18 hours and she ovulates at about 12 hours post-estrus. The best conception results when breeding occurs during a period covering the last 8-10 hours of standing estrus and a few hours thereafter. The rule of breeding cattle first noticed in estrus of the morning during the afternoon of that day and breeding those first noticed in estrus of the afternoon during the following morning works well in most cows.

It follows that heat detection is a very important job if maximum conception is to be accomplished. The cattle should be turned out at least twice daily for a minimum of 30 minute observations. The most dependable sign is, of course, standing for mounting. In all too many cases, what we may regard as a "silent heat" is really a missed heat because of a lack of close observation.

3. Breed at the proper time after calving. For maximum production, cattle should not remain open for

prolonged periods. However, a recovery period of 60-70 days after calving is needed before breeding is attempted. Breeding earlier than this will result in lowered conception rates and if conception does occur it is more likely to terminate with embryo death. Such terminations tend to lower chances of conception at the second breeding.

4. Confirm pregnancy by pregnancy testing. The most reliable method in practice for detecting pregnancy in the cow is that of rectal palpation which can be done as early as 35 days post-breeding.

In too many cases, heat records alone are used for this purpose. A cow should never be assumed pregnant because she does not return to heat. Such may in fact indicate a reproduction problem such as a persistent corpus luteum.

On the other hand, because a bred cow returns to heat does not always mean she is open. A small percent of cows do show heat one or more times during pregnancy. Reinseminating such returns must be done with care to prevent an induced abortion.

It is highly recommended that veterinary services be used to detect pregnancy by the rectal method.

5. Health program and the use of AI. One should keep in mind that selection of disease-free breeding stock, isolation of newly purchased animals, vaccination programs and periodic health checks are more effective than treatments. If disease should strike, however, treatments should be prompt to avoid any unnecessary losses and the spread of the disease. The dairyman must work closely with his veterinarian on a herd-health program. Monthly visits to check for pregnancy, disease and general health would be desirable.

Artificial insemination (AI) is a procedure that not only allows for genetic improvement of the herd, but fortunately it also provides a means to maximize conception rates. The fertility values of bulls will differ and AI makes it possible

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to use highly fertile semen. AI is also a procedure which, because of bull-health programs in AI associations and the addition of antibiotics to semen, helps to control the spread of infectious reproductive disease.

6. Use a proper nutritional program. Inadequate feeding can cause serious fertility problems. Nutritional factors such as energy, protein, vitamin A and phosphorus have definite roles in reproductive processes.

Fortunately, there are no nutrients required for reproduction that are not already required for growth and/or lactation. Because of this and because nutritional demands for reproduction are relatively small when compared to those for lactation, for example, if one feeds well for growth and lactation, then nutrition will generally be sufficient for reproduction. But in the case of high producing cows, there appears to be a tendency to use nutrients for milk production at the expense of reproduction.

7. Use proper cattle handling procedures. Any mistreatment or excitement that disturbs the general well being of an animal can lead to reproductive disturbances. Any treatment that results in injury to reproductive tissue may also cause problems. In this regard, proper care at critical periods such as the time of calving, like avoiding premature assistance, will do much to contribute to better calf survival and better success in re-breeding.

8. Maintain good records and use them. Records that relate to reproductive activity such as breeding dates, calving dates, heat dates, dates and nature of any disturbances and treatments used can be of value to both the producer and veterinarian in solving reproduction problems. The dairyman should always watch for danger signals for reproductive disturbances. Some common ones that should be given immediate attention if noticed are:

### Robert D. Appleman Professor of Animal Science

The purpose of the milking barn facility is to harvest the dairymen's product—milk. The personnel and equipment involved in the harvesting process, to be efficient, should be designed to function so that the following criteria are achieved:

- a. maximum production,
- b. healthy udders,
- c. maintain milk quality after its removal from the cow,
- d. efficient use of available labor, and
- e. worker comfort and convenience.

Milking labor accounts for approximately 85% of the annual cost of milking and 55% of the total dairy farm labor expenditure. The milking process has experienced

\*The author is indebted to Mr. Neil Micke, graduate student, who has collected and is analyzing this data in partial fulfillment of his thesis research requirement for successful completion of a M.S. degree in the Animal Science Department, University of Nebraska.

a. Abnormal discharges from the reproductive tract of the cow. Any discharge that deviates from a relatively clear color and/or has a strong odor should be of concern. An except is a minor bleeding that is apparent a day or so after heat in some cows, because this is a normal event.

- b. Open cattle not cycling.
- c. Heat periods of irregular length or exaggerated intensity.
- d. Estrous cycles longer than 28 days or shorter than 15 days.
- e. Cows requiring more than 3 services to conceive.
- f. Any evidence of abortions.
- g. Any alterations in the reproductive system such as prolapses of portions of the reproductive tract or retained afterbirths.

# Streamlining Milking Techniques\*

Table 1. Relationship of Udder Pressure and Flow Rate

Machine Applied:	1 min.	2 min.	3 min.
Av. Flow Rate (Lb/Min)	4.3	4.8	4.4
Required Machine Time (Min)*	4.65	4.17	4.54

\*Average required "machine time" to obtain 20 lb. milk per milking.

less improvement in production efficiency than most other agricultural enterprises. Many attempts to achieve more production per man-hour of labor have resulted in reduced milk quality.

While increasing the cows per hour is a worthwhile goal, it is questionable whether such is commendable at the expense of either production per cow or udder health.

As cows per hour has been increased with parlors, pipelines and more mechanization, many dairy specialists feel that the recommended practice of *attaching the milking machine about one minute after preparing the cow for milking* has not been followed. When at-

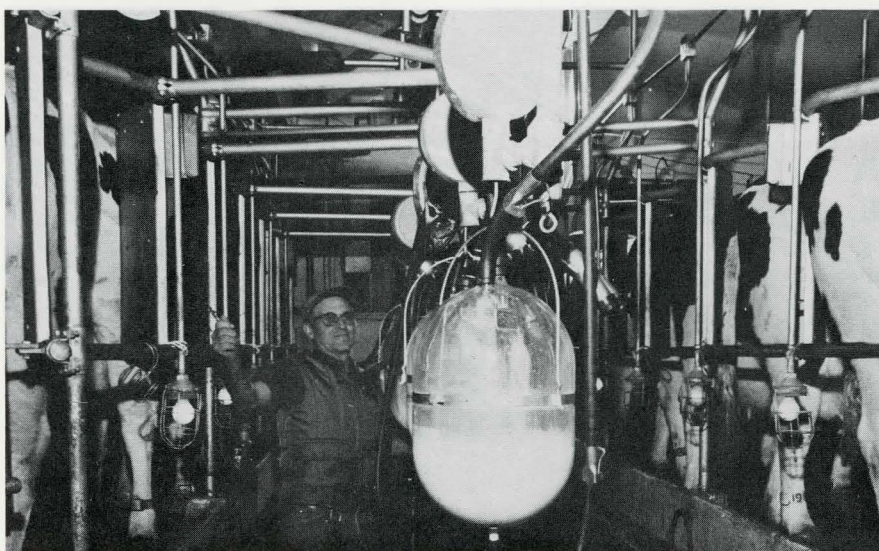
### Unrecognized Problems

Unfortunately, a number of causes of reproduction problems remain unrecognized or unknown. Our inability to directly observe processes such as the formation of sperm and egg cells, fertilization and ovum implantation severely limits progress in analyzing breeding problems of individual animals.

Additional research directed toward learning the mechanisms by which various factors such as hormonal, nutritional and genetic factors influence reproduction is a prerequisite to developing effective methods for improving fertility.

The more we can understand about our animals through research the better able we will be to treat for reproductive disturbances and to manage for the most efficient production.





University herringbone where some of the time motion studies were conducted.

tachment is delayed, say beyond three minutes, the let-down hormone effect is minimized and less milk may be harvested. Secondly, prolonged machine milking after milk flow has approached zero may result in increased udder irritation. Continued over-milking, thus, may result in increased leucocyte and/or bacteria count.

#### Milking Procedures Studied

A study of milking procedures in various types of milking parlors used in Nebraska was undertaken. The purpose of this study was to determine if milking routines in a herringbone or side opening parlor could be altered to improve production efficiency, and at the same time, reduce the frequency of both delayed attachment of the milking machine to the udder and prolonged over-milking. A second purpose was to identify specific activities in a milking routine that are time consuming and might be reduced with effective mechanization.

The variables studied included:

- a. milking facilities,
- b. man differences, and
- c. cow production level.

To date, time motion studies have been made on 35 different combinations of variables, each including about 48 cows.

#### Preliminary Conclusions

Results of this preliminary study indicate that some milking routines are better than others in terms of (1) improved cow preparation time and (2) reduced over-milking. At the same time, the number of cows milked per hour, even without further mechanization, may be increased.

Furthermore, it has been shown that the combined mechanization of washing udders, using crowd gates to move cows to the parlor, and feeding outside of the parlor could result in a 60 to 70% increase in milk produced per hour of labor and still maintain proper milking techniques. A fourth mechanization feature, that of automatic teat cup removal, appears promising and these preliminary data suggest that the combined effect of all four labor-saving devices, compared with today's typical parlor, could result in a doubling of the amount of milk produced.

#### Specific Results

1. Two factors that contribute materially to "machine milking time" are: (a) level of production and (b) time interval from starting cow preparation to the application of the milking machine on the cow's udder. High producing cows do require more machine time than lower pro-

ducing animals. Thus, division of the herd into production level strings or sub-herds, when the herd size is large enough to justify a division, does result in more uniformity among cows and allows the dairymen to better manage their milking routine to promote proper milking.

Important variations in milk flow rates, due to differences in preparation time when milk yield is held constant at 20 lb. per milking, were noted. When the machine was applied at 1, 2, or 3 minute intervals after washing udders, milk flow rates averaged 4.3, 4.8 and 4.4 lb/min., respectively. This means that the required machine milking time averaged 4.65, 4.17 and 4.54 minutes, respectively (Table 1). The contributing factor is that when the machine was applied either too early or too late, the internal udder pressure was lower and the cow did not help as much in the milking process.

2. Many cows' udders were washed (prepared for let-down) too early. Excessively long preparation times were observed to be a function of *group washing*, that is, washing more than one cow ahead of transferring the milking machine from one cow to another. In one set of observations with the same 96 cows, one man attached the milking machine within 3 minutes after preparation in every instance. Twelve hours later, another man in the same parlor and with the same cows, waited an average of 4.5 minutes to apply the machines on 57 of the 96 cows observed.
3. Milking routines that reduced the steps required by the milker (man) and that minimized the duration of machine stripping tended to increase the average flow rate, the number of cows milked per hour, and the milk produced per man-hour of labor without increasing the frequency of either: (a) prolonged preparation time, or (b) over-milking.

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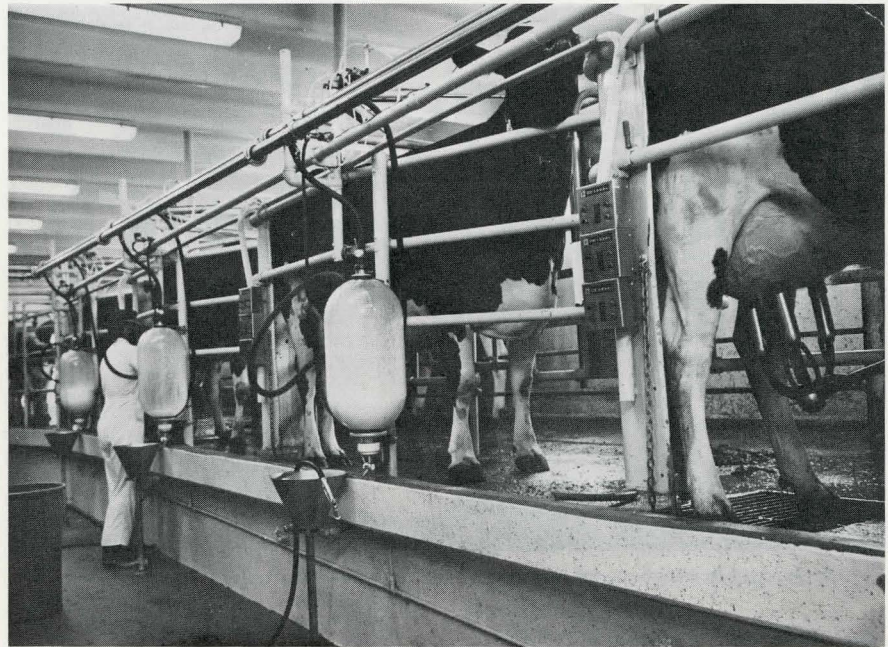
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4. In the typical side-opening milking parlor, about one-fourth of the time spent with each cow was moving her in or out of the stall (0.45 min.). Other time-consuming chores included: washing and drying the udder (0.33 min.), applying and adjusting the milking machine (0.29 min.), and removing the machine (0.21 min.). Those chores that appear to have the best opportunity to be mechanized economically and thereby improve the overall efficiency include: (a) washing udders, (b) feeding, and (c) cow movement (Table 2).

5. In the typical herringbone parlor, only one-eighth of the time is spent moving each cow (0.18 min.). This is because groups of cows are involved, rather than individual cows which is the case in the side-opening parlor. However, more than one-half of the time involved in moving cows in the herringbone parlor was spent in the holding corral. This prevented the milker (man) from caring for other milking units when they may have needed attention. Thus, it appears that the same three chores (washing udders, feeding and cow movement) could be effectively mechanized (Table 2).

6. A number of different factors contribute to how many milking machines can be properly operated by one man in the milking barn. The author has concluded that the machine time required per cow is a function of: (a) cow production level and (b) milking equipment design and function. Machine time may vary, according to the time-motion studies summarized here, from 3.5 to 5.0 minutes per cow.

The number of milking machines to be used is further dependent on: (c) the design of the milk barn and (d) the man, himself. One man can effectively operate from 2 to 5 machines (Table 3).



Time motion studies were made in this side opening parlor.

Table 2. Probable Influence of Mechanization on Chores Involved in Milking

Chore	Type of Parlor			
	Herringbone		Side-Opening	
	(Time spent on specific chores—minutes per cow)			
	Typical	Mechanized	Typical	Mechanized
Wash & Dry Udder	0.33	0.13*	0.33	.09*
Apply & Adjust Machine	.29	.29	.29	.29
Remove Machine	.21	.21	.21	.21
Dipping Teats	.09	.09	.09	.09
Feeding	.10	.00*	.10	.00*
Moving Cows	.45	.11*	.18	.11*
Other	.20	.20	.20	.20
TOTAL TIME	1.67	1.03	1.40	.99
% Improvement		62		41

\*Highly mechanized system includes: (a) effective udder washing system, (b) either automated or no feeding of grain in parlor, and (c) efficient cow movement utilizing crowd gates and positive action entry and exit gates and doors.

Table 3. Number of Milking Units to Be Used by One Man

Required machine milking time*	Situation			
	Side-Opening		Herringbone	
	Typical	Mechanized**	Typical	Mechanized**
(min.)	(No. of milking units in use & provide for proper milking)			
3.5	2.1	3.4	2.5	3.5
4.0	2.4	3.9	2.8	4.0
4.5	2.7	4.3	3.2	4.5
5.0	3.0	4.8	3.6	5.0

\*Required machine milking time, including minimal machine time and little, if any, apparent over-milking.

\*\*Highly mechanized system includes: (a) effective udder washing system, (b) either automated or no feeding of grain in parlor, and (c) efficient cow movement utilizing crowd gates and positive action entry and exit gates and doors.



# Value of a Bacterial-fungal Culture on the Preservation and Feed Value of Alfalfa Silage

F. G. Owen and R. D. Appelman  
Professors of Animal Science

The usual reasons for adding cultures to silages is to, hopefully, improve preservation of ensiled nutrients or to enhance the value of the nutrients ensiled, or both. As a group, it appears that most cultures which stimulate acid production will speed up the normal process of ensiling, reducing the time required for silage to reach a stable acidity. In this way it appears that they reduce oxidative losses.

It should be acknowledged that cultures used in various experiments and those available commercially from different sources may vary considerably in potency and types of organisms present. This may help explain why the results from tests with such products have been variable.

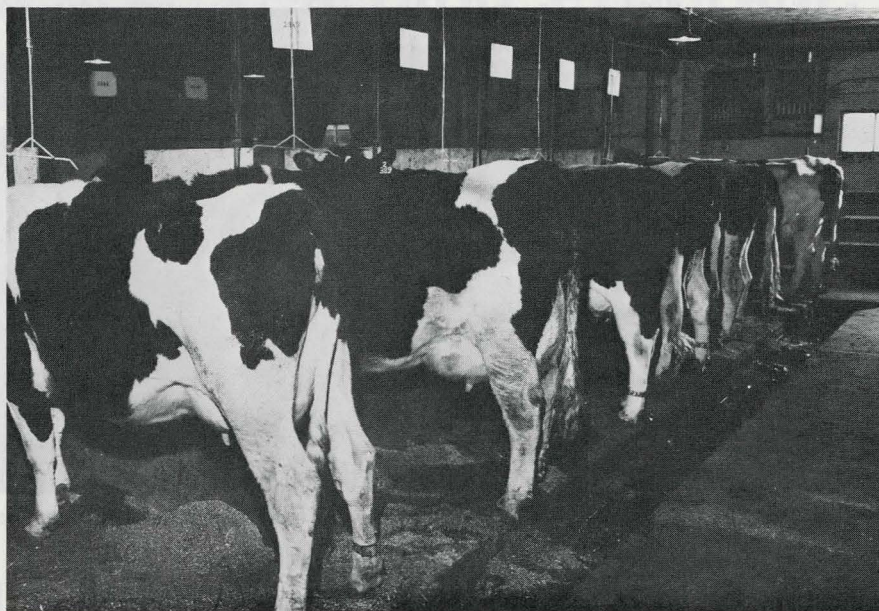
## Experiment

In a trial conducted at the Mead Field Laboratory, direct-cut alfalfa forage was used in a trial to evaluate a product called Silogen®, which contains *Aspergillus oryzae* and a lactic culture of microorganisms. The additive was applied manually at the rate at 1 lb. per ton, on top of the forage as it was spread on the stack.

We used Holstein cows in a short-term trial to determine whether any effects of the additive were coming from its influence on silage fermentation or from its own effect on the cow. We also measured digestibility using these same animals.

## Results

*Nutrient preservation.* Preservation was measured at two levels



Milk cows are individually fed to determine feed intake, feed digestibility and milk production levels.

in both ends of the stack, at about 18 inches below the surface and at about a 4 foot depth. *Table 1* gives the data. Preservation of dry matter was significantly improved by the additive (67.5% vs. 71.8%). This improvement was greatest for the top location.

Protein preservation was also increased significantly from 62.6 to 68.7% by the preservative. Again the treatment was effective both in the surface and internal locations. However, it was more effective internally. The reason for the unexpected preservation near the surface than for the more internal location is unclear.

*Milk production and composition.* The feeding trial involved individually fed Holstein cows full-fed the silages mixed with a grain ration as a complete feed. The grain approximated 40 percent of

Table 2. Effect of Silogen on Lactation

	Control	Silogen in Silage	Silogen in Grain
Milk yield, lb/day	44.3	43.8	43.0
Fat, %	3.62	3.98*	3.72
FCM yield, lb/day	42.4	43.0	41.4
Feed intake, lb/day	104	105	106
DM intake, lb/day	38.8	36.9**	39.2

\*10% higher fat% than control

\*\*5% less dry matter than control

the dry feed. Results from feeding the silage are shown in *Table 2*.

Milk and fat-corrected milk (FGM) yields were similar for the three treatments, but tended to be lower for the treatment having Silogen added in the grain. However, differences were not statistically significant.

Milk fat test was increased significantly from 3.62 to 3.98% by the silage additive. The reason for this effect is not known, but could be related to differences in fermentation products produced during ensiling.

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Table 1. Nutrient Preservation (%)

Location	Dry Matter		Protein	
	Control	Treated	Control	Treated
Top 18"	65.7	71.3	65.7	70.5
Center	69.3	72.3	59.6	66.9
Average	67.5	71.8	62.6	68.7



(continued from page 19)

Solids-not-fat and weight gains were not affected appreciably by treatments.

**Feed intake and efficiency.** Intake of the three rations as fed (wet basis) was almost equal for all treatments. However, on a dry matter basis intake was significantly less for cows fed the Silogen treated forage. This amounts to 7.3 percent more FCM per pound of dry matter for the treated silage compared to the untreated silage. Improved efficiency with higher moisture silages has been noted in other experiments at Nebraska.

**Ration digestibility.** The ration containing treated silage gave the highest average digestibility for all ration components (Table 3). The ration having the additive in the grain ration tended to lower digestibility. Digestibility of protein was increased by 7.9 percent by Silogen addition to the silage and was the only effect which had statistical significance.

### Conclusions

In this experiment addition of Silogen, a product containing cultures of microorganisms, improved protein and dry matter preservation, but had little effect on milk yield.

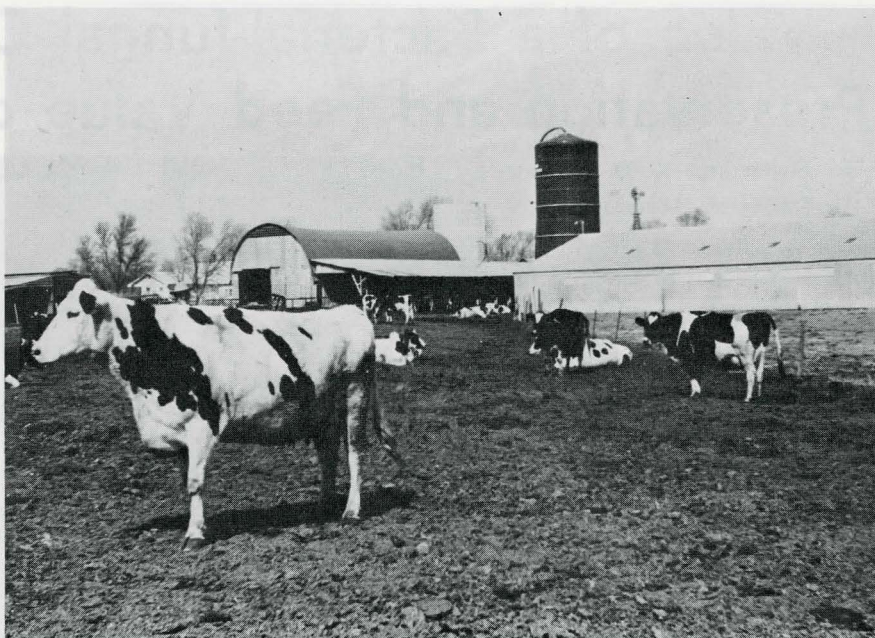
However, the additive resulted in significant improvements in milk fat test, protein digestibility and, by reducing dry matter intake, improved efficiency of milk production.

Additional trials are needed as a basis for recommendations for the use of this type preservative.

Table 3. Ration Digestibility

	Control	Silogen Silage	Silogen Grain
Dry matter	62.0	62.8	59.5
Crude protein	55.9	60.3*	56.3
Crude fiber	46.9	48.5	47.4
Ether extract	59.7	60.3	57.4
NFE	71.0	71.2	67.5

\*Significantly different from control



A portion of the milking herd on one of the farms included in the cost study.

## Cost of Milk Production Study

Robert D. Appleman &  
Philip L. Kelly

Professors of Animal Science

The dairy industry of Nebraska has changed rapidly in the last ten years. Economic pressure is causing dairymen to expand production and improve efficiency or get out of business. There was an 8 percent reduction in the number of market-milk producers in 1971.

The Animal Science Department's Dairy Advisory Committee, consisting of eight Nebraska dairymen, first encouraged the University of Nebraska to undertake this study in 1969. The specific objectives developed at that time were:

1. Determine realistic costs of producing milk, including feed, labor and fixed costs.
2. Determine the effects of production per cow, herd size and other identifiable variables on the cost of producing 100 lb. of milk.
3. Determine net returns to labor and capital expected from the dairy enterprise.

Twenty-nine Nebraska dairymen have cooperated in this study. Frequent visits to each cooperator's farm were made during the 1-year data collection period. At this time,

coding of the data for analysis and a check for completeness is nearly finished. Results should be forthcoming by fall.

The University of Nebraska Animal Science and Agricultural Economics Departments are indebted to the dairymen who have so diligently cooperated in this study.

They are:

Cedar Farms (Harvey Vollmer), Falls City  
Carl Dierking, Syracuse  
William Ehrisman, Beemer  
Rudolph Glaesmann, Fairbury  
Robert Glinesman, (was at Phillips)  
William Goosen, Holmesville  
Kenneth Groves, Tecumseh  
Peter Halmes, Plattsmouth  
William J. Hamm, Beatrice  
Hirschler Dairy Farms, Harbine  
Daniel Johnson, Mead  
Lloyd & Roland Johnson, Hershey  
William Kruger, Clearwater  
Leonard Maschman, Daykin  
Walter Hanish, St. Paul  
Reuben Meier, Grand Island  
Otto Brothers (Norris Otto), Phillips  
Phillips Brothers, Beaver Crossing  
Delmer Roth, Milford  
Charles Sandfort, Humboldt  
Ernest & Duane Sellin, Norfolk  
Stork Brothers, Arlington  
Lewis Vandersnick, Ewing  
Harold & Mike Vitosh, Blue Springs  
Meinert Wissman, Falls City  
Tom Wright, Reynolds  
Charles McConnell, Hershey  
Edgar Korte, Leigh  
Lester Lueders, Tecumseh



# A Look at the University's Dairy Production Teaching Program

Robert D. Appleman

Professor of Animal Science

The Dairy Option is one of six options available to undergraduate students in the University of Nebraska animal science major. The Dairy Option is designed to train students for employment either on specialized dairy farms or in industry where milk production and distribution are the primary activities.

In recent years, a number of innovations and new techniques in the teaching program have been implemented and are now an integral part of the animal science program.

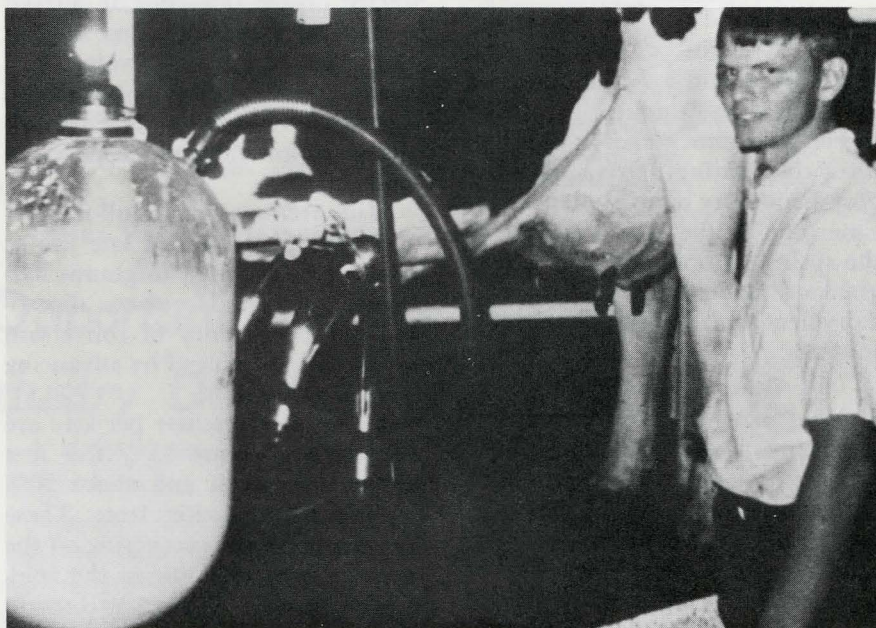
## Dairy Farm Experience

One of the more exciting programs of special interest to a limited number of dairy students is the summer management training program. The object of the program is not just to provide a summer job, but rather to provide the student with insight into business management, employer-employee relationships, public relations and promotion, as well as the usual breeding, feeding and health management practices.

Carl Rood of Wahoo, who graduates in May, is the first dairy major to successfully complete this program. Carl's participation in this program, earning him 3 semester hours credit during the summer between his junior and senior year, includes the following activities:

1. Student and instructor have conference with prospective employer during the preceding spring semester to outline those experiences which the student should encounter during the work period.

2. Student employed on dairy farm or in agribusiness organization for at least 10, preferably 12, weeks. Instructor to visit with student and employer at least once during this period.



Carl Rood admiring his favorite cow at AJR farm.

3. During the employment period, the student prepares a description of the facility and an outline of the operations.

4. During the fall semester following employment, the student completes a written term paper and presents an hour oral seminar report about his experiences. One purpose of this paper and seminar is to help the student relate his field experiences to his previous classroom experiences. A second purpose is to help him decide what further course work he needs to take.

Carl Rood was employed in 1971 at the AJR Farm, operated by Jay Hop of Greeley, Colorado. This is a highly mechanized 250-cow herd of registered Holsteins, employing only four men besides Jay. What was Carl's reaction to the experience? His concluding statement in the written report stated, in part:

"It's difficult to put all I learned on paper. It didn't seem like a job, I felt more like one of the family. My only criticism is that the summer was far too

short. I guess I have to be the luckiest kid in the University, because I really didn't know if I was qualified to work on such a well managed dairy. I enjoyed the summer so much that I wouldn't mind going back next summer. I do hope that other students will have the opportunity to gain the experience, wisdom and hospitality of the Hop family."\*

Another student will have just that opportunity. Bob Brummels, a junior student from Hartington, is scheduled to enroll in the 1972 summer program with employment again planned at AJR Farm.

## The Expanded Program

To develop this concept even further and to provide the student with an even better opportunity to learn how a successful dairy operation is organized, a curriculum involving a 6-month employment

*(continued on next page)*

\*Carl's participation in the summer program has been beneficial to him. He was offered, and has accepted, employment at AJR Farm after graduation in May.



(continued from page 21)

period combined with specific business oriented courses (accounting, business law, money and credit, insurance and personnel administration) has been approved. The student would earn 16 semester hours of credit while employed on the farm and would spend only 7 semesters on campus.

The program makes it possible for a cooperating dairyman to employ University dairy students full-time (one in the fall, a second in the spring). Hopefully, such a program will appeal to both Nebraska dairymen and University dairy students.

#### Other Innovations

Other new teaching techniques are being used in "problem solving" approaches to conventional classroom teaching. For example, computer simulated "breeding herds," where the student selects what he thinks are the best of the available sires to mate with his cow herd, is used in animal breeding.

Two-way telephone communication by the class with farmers or agribusinessmen in their office, with the slides of the business operation being shown simultaneously on the screen in a conventional classroom setting, is another recent development. This provides the student with an opportunity to converse with businessmen, without the involvement of time-consuming and expensive transportation.

#### The Best of the Past

With these developments, the older established and valuable programs are still maintained. A dairy cattle judging team, field trips in dairy management classes and student clubs (Block & Bridle) remain available to those students desiring to avail themselves of these activities.

With the move of the dairy herd to Mead, student employment on the University dairy farm is somewhat limited. We do currently employ part-time students (primarily on weekends) at Mead and three students in the research laboratories on campus.

## Effects of Frosting of Atlas Sorghum On Yields and Feeding Value

A three-year study is being conducted on the influence of delayed harvest of forage sorghum on forage yields and feeding value. Previous Nebraska research has shown a progressive yield increase for forage sorghums up to just before frost.

Milk yields of cows full-fed forage sorghums harvested late are as good or better than sorghums harvested earlier. However, digestibility and efficiency of conversion to milk were reduced by advancing maturity.

Yields of dry matter per acre are reduced by about 15% the first month after frost and about 30% by two months after frost. These data are based on recovering *all* the material still available in the field.

The frosted sorghums will retain moisture better than corn after frost and appear to have ample moisture for preserving in an up-

right silo at least one month past frost. At two months after frost chopping and packing are more difficult.

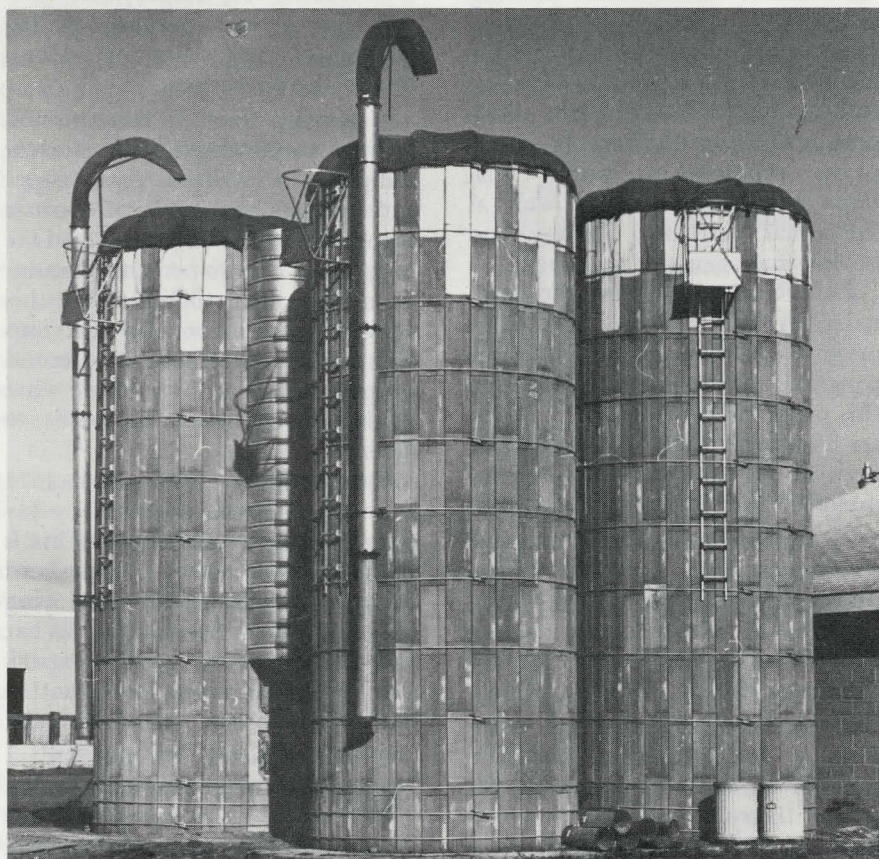
The first years feeding data indicate that feeding value for lactating cows is at least as good for sorghum harvested one month past frost as for that harvested at the time of first frost. Feeding value appears to be slightly lowered at two months past frost.

Disgestibility of protein and nitrogen-free extract were improved by frosting.

Thus far no evidence of health problems have been encountered during feeding of these sorghums.

If current trends continue in further evaluations, delayed harvest could afford an alternative means of harvest when silage storage is limiting.

Project leader: Foster G. Owen



Three 25 ton silos used to store silage cut at three stages of maturity.



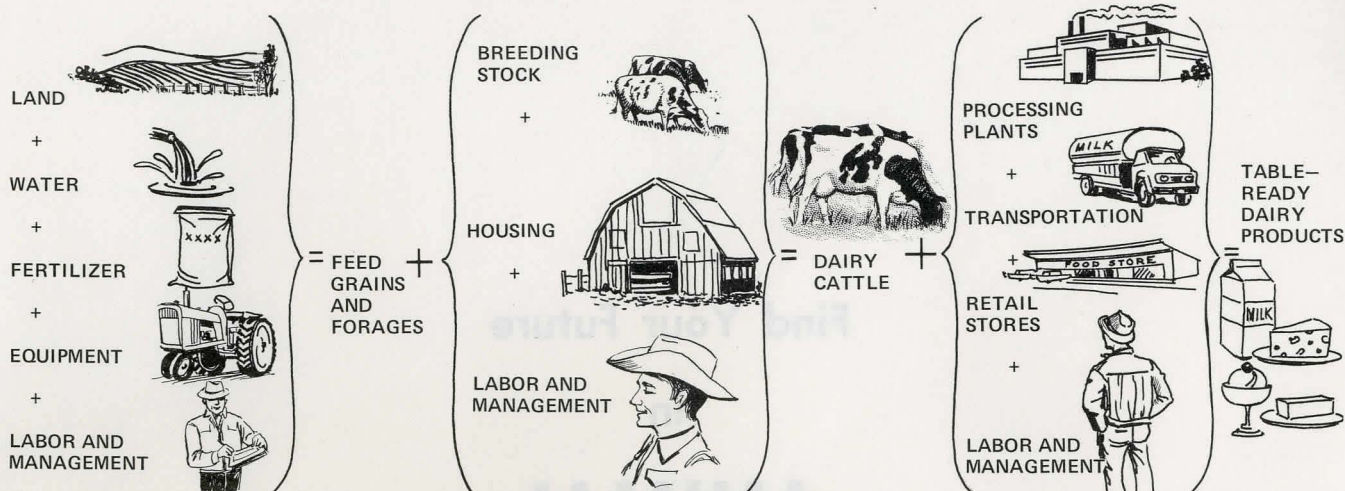


Figure 1. Value is added in each step.

## The Dairy Opportunity in the Nebraska Livestock Industry Development Program

Frank H. Baker  
Chairman

### Animal Science Department

Economic growth through the development of the animal sector of agriculture is one of Nebraska's great future opportunities. This opportunity is three-dimensional.

1. Developing animal production to completely convert Nebraska's feed and forage production to animal products.

2. Developing operations to process all Nebraska-produced animal products into retail-ready products.

3. Developing land and water resources for new feed-producing capacity to be used in animal production and distribution systems.

Nebraska's greatest strength for competition with other geographic regions for a major share of the future market for milk and meat lies in its feed supply. Feed represents two-thirds or more of the cost of production of all animal products.

Only 59 percent of Nebraska's feed grain was fed to livestock within Nebraska during the last 5 years of the 60's. There were 5.2 million tons of unused feed grain each year. A million tons of feed grain can yield one of the following:

1. 2.33 billion pounds of milk.
2. 667,000 choice slaughter steers from 700 pound yearlings.

3. 300,000 litters of market weight hogs.

Nebraska has the feed supply today to more than double its animal enterprises. Increases in irrigated acres will produce an even greater abundance of feed grain. It appears that Nebraska's feed supply is, or will be in the future, the greatest unprogrammed feed grain supply in the U.S.

### Adding Value

The generation of new wealth in Nebraska communities by adding value to feed resources through their use to produce milk and meat can be the basis for economic growth. When 400,000 to 500,000 bushels of feed grain are used to produce animal products it has the wealth generating capacity equal to a small industrial plant that employs 100 people. Thus, feeding the grain from 25 farms that produced 300 acres of feed grain with yields of 67 bushels per acre would generate wealth equal to the small industrial plant that employs 100 people. The actual production of the grain on these 25 farms generates wealth about equal to another small industrial plant.

According to data from a national survey by the U.S. Chamber of Commerce in counties not joining a major metropolitan area, including Platte County, Nebraska,

100 new manufacturing workers in the community meant: 359 more people, 91 school children, \$710,000 personal income, \$331,000 retail sales, \$229,000 bank deposits and 3 new retail firms.

The dairy cow is well-known as an efficient converter of feed to highly nutritious human food. Nebraska's dairymen and their efficient operations can be an important part of future economic development in the rural communities. To achieve the maximum for their own benefit and for the benefit of their community and state, dairymen must join their neighbors in action programs.

All Nebraskans must work together to use the strengths of animal agriculture for their full potential for economic growth of Nebraska. It is particularly important that producers, processors, marketing and service agencies and investors work vigorously toward common goals.

The University of Nebraska must also work vigorously and cooperatively with the entire industry toward achievement of these goals. The University, properly funded, can make significant contributions of new technology through research, new personnel through undergraduate teaching and can assist in solving industry problems through "Education for Action" projects in Extension.



Find Your Future

in

# ANIMAL SCIENCE

at the

UNIVERSITY OF NEBRASKA

## CURRICULUM OPTIONS

Undergraduate programs for Animal Science majors and for other students in the College of Agriculture help develop the student's capability to cope with problems of Nebraska's livestock industry. Because of the size of this livestock industry—65% or more of Nebraska's agricultural income—all agriculturists who work in Nebraska must understand livestock production. Many options are available in the undergraduate Animal Science program. These include:

- |                                   |              |
|-----------------------------------|--------------|
| 1. Production—Beef, Sheep & Swine | 4. Science   |
| 2. Range Production               | 5. Business  |
| 3. Dairy                          | 6. Education |

## DAIRY

*Dairy Option* is designed for students desiring a career in the dairy industry where milk production and distribution is the primary focal point.

