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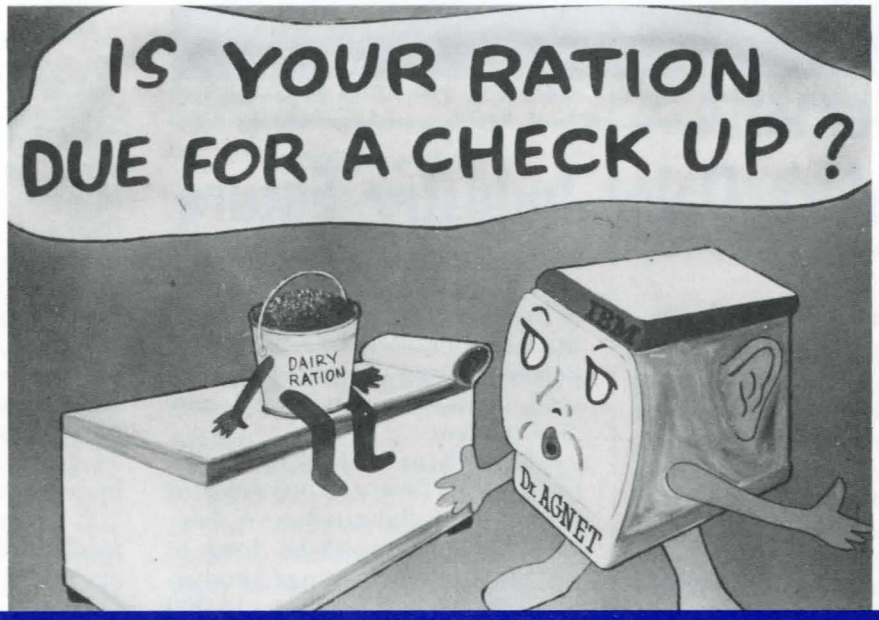

1978-1979 DAIRY REPORT

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Leo E. Lucas, Director

The Agricultural Experiment Station
Institute of Agriculture and Natural Resources
University of Nebraska–Lincoln
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TEACHING RESEARCH EXTENSION
Institute of Agriculture and Natural Resources

During the past 14 years Nebraska dairy cow numbers have decreased 55 percent, production per cow has increased 55 percent, and herds have become larger and more specialized.

Nebraska's Dairy Industry Future

Irv Omtvedt
Head
Department of Animal Science

Although Nebraska's dairy cow population has been declining since 1934, dairy production is expected to continue to be an important component of Nebraska's agricultural economy.

Nebraska has the resources and demand for an expanded dairy industry. Table 1 clearly indicates that Nebraska has the grain and forage producing potential to support a strong dairy industry, and irrigation expansion in the state should enhance this potential even more. Nebraska currently imports about 6 million pounds (2.7 million kg) of fluid milk each month to meet demands.

Numbers Down, Production Up

In 1978, there were approximately 126,000 milking cows distributed among 3,600 farms—an average of 35 cows per farm. This represents a 55 percent reduction in number of cows and an 87 percent decrease in number of farms in the past 14 years (Table 2). Production per cow increased 54.5 percent during that time and total milk production decreased only 30.4 percent.

Although many factors can influence the future, it is projected that by 1985 the number of dairy cows in the state will be down to 100,000 and the average production per cow will be up to 11,000 pounds (4,990 kg)—resulting in a 14 percent further reduction in total milk production. However, increasing the acres of irrigated land in Nebraska should have a positive effect on the dairy industry since increased irrigation usually results in a corresponding increase in animal agriculture. For example, dairy cow numbers in Holt County have increased during the past two years as irrigated acres increased.

The sparcity of Nebraska's dairy population and the distance from markets pose potential problems. It is difficult and expensive to properly service dairy herds that are many miles apart and considerable distance from centers of consumption. As the number of dairy operations in the state decreases, labor availability becomes increasingly critical because it is more difficult to find persons with dairy knowledge and experience. The industry needs to work jointly with the University in encouraging young people to study animal agriculture.

Table 1. Nebraska grain and forage production in 1977.

Commodity	Amount (1,000)		National rank
Grain			
Production	(bushels)[a]		
Sorghum grain	151,230		3rd
Corn grain	628,650		4th
Winter wheat	103,250		4th
Oats	38,860		6th
Soybeans	1,530		21st
Forage			
Production	(tons)	(MT)	
Sorghum silage	1,265	(1,150)	2nd
Hay production	7,464	(6,784)	4th
Alfalfa hay	5,440	(4,945)	5th
Corn silage	6,110	(5,554)	6th

[a]U.S. bushel equals 2,150 cc.

Future Changes

Nebraska's dairy industry has made significant strides in recent years and the future is expected to bring several more dramatic changes. Although there are many factors that can influence what happens, some of the characteristics of the dairy industry of the future include:

1. Size of individual operations will continue to increase. The average number of cows per farm increased by 265 percent in the past 14 years and another 14 percent increase is expected by 1985.

2. Operations will become more mechanized with emphasis on energy and labor efficiency. The shortage of qualified labor will force modernization and increased efficiency. It is encouraging to see 1,400 Nebraska youth currently enrolled in 4-H dairy projects.

3. New types of feeding programs will be developed. More emphasis will be placed on evaluation of feedstuffs for quality. Researchers are currently attempting to produce single cell proteins through fermentation of waste products by microorganisms. Other non-traditional feedstuffs will be used effectively in future feeding programs. New grain varieties with improved feeding quality will be developed. Feed selection and ration formulation will become more scientifically based as availability of computers and computer programs become commonplace in most dairy operations. Separating cows into different feeding groups within a herd according to production will permit improved feeding efficiency.

Table 2. Dairy cow trends in Nebraska.

Year	Total No. cows	No. herds	No. cows per herd	Milk yield per cow (lb)	(kg)
1964	280,000	29,100	9.6	6,600	(2,994)
1970	174,000	14,000	12.4	9,000	(4,082)
1974	158,000	9,500	16.6	9,348	(4,240)
1978	126,000	3,600	35.0	10,200	(4,627)
Projection:					
1985	100,000	2,500	40.0	11,000	(4,990)

4. Dairymen will follow breeding programs that will achieve increased productivity. Only 24 percent of the dairy cows in Nebraska are currently on a production testing program. This percentage is expected to be much higher in the future. Increased use of artificial insemination and more effective sire selection will help achieve maximum genetic potential from the herd. Economics will force a higher percentage of the cows to be production tested in the future. The 24,522 cows tested in Nebraska's DHIA program in 1977-78 averaged 13,178 lb (5,978 kg) milk compared to the state average of 10,200 lb (4,627 kg). Considering milk at $10/cwt (45.4 kg), this means the average cow on test grossed $297.80 above the state average. If the state average could be raised to the DHIA average, Nebraska dairymen would gross an extra $30 million annually or it would take 28,474 fewer cows (22.6%) to produce the 1978 total milk production.

5. Herd breeding efficiency will be improved. Current research emphasis on heat detection and rebreeding problems plaguing the industry should result in breakthroughs that will greatly improve the overall reproductive efficiency for the average producer. The 338 Nebraska herds responding to Foster Owen's survey in November 1977, indicated heat detection, conception rate, and reproductive disorders were the three primary management problems (An. Sci. Dept. Publ. 2-78).

Full Potential

To realize the full potential, industry and the University need to work hand-in-hand. The fact that operations are becoming larger means that each management decision has greater economic significance and the line between failure and success becomes more narrow.

The Institute of Agriculture and Natural Resources at the University of Nebraska–Lincoln is dedicated to serving the needs of the dairy industry through extension, teaching, and research. County extension agents, district specialists, and faculty in several departments on the East Campus are available to Nebraska's dairy industry. Table 3 gives the names of Animal Science staff and other Institute of Agriculture and Natural Resources faculty with dairy program responsibilities.

Table 3. Institute of Agriculture and Natural Resources faculty with dairy program responsibilities.

Name	Program distribution, % Extension	Teaching	Research	Primary responsibilities
Agricultural Economics Department:				
Mike Turner	50%		50%	Dairy Marketing
Agricultural Engineering Department:				
Gerald Bodman	80%		20%	Dairy Housing
Animal Science Department:				
Phil Cole	75%		25%	Dairy Management, Youth Programs, Supervisor of Dairy Research Unit
Franklin Eldridge		30%	70%	Cytogenetics & Dairy Breeding Dairy Judging Team Coach
Don Kubik	100%			District Dairy Specialist Dairy Farm Economics
Larry Larson		30%	70%	Dairy Physiology Dairy Production Instructor
Foster Owen	32%	20%	48%	Dairy Nutrition, Instructor for Computer Feeds & Dairy Production
Ken Bolton		25%	75%	Dairy Unit Manager
Food Science & Technology Department:				
Stan Wallen	80%		20%	Dairy Processing
Veterinary Science Department:				
Duane Rice	100%			Dairy Herd Health

Manure Management

A Look at the Alternatives

Gerald R. Bodman
Elbert C. Dickey
Extension Agricultural Engineers

Many dairymen are considering changes in their manure management system. Some reasons cited are: shortage of labor, soil compaction, expansion of operation, shift in available management skills, loss of crop nutrients, pollution, and equipment life. Regardless of the reason, dairymen should take into account both present and future needs as they relate to possible increases in animal numbers or changes in the overall farming operation.

For most dairymen, two basic manure handling systems are available: 1) daily hauling and 2) storage before land application. In a few cases there might be an intermediate processing option, such as methane production, drying, composting or liquid/solids separation. These do not represent a means of final disposition of manure and hence are merely components in larger overall systems. Additionally, each processing alternative has other requirements. For example, methane production requires development of an efficient use of the methane produced and composting and drying require the development of a sound reliable marketing outlet.

Daily Hauling

For many dairymen, daily hauling is still the preferred and most satisfactory system. Daily hauling does have disadvantages which lead some producers to consider storage as part of the manure management system. When compared with a storage system, daily

(Continued on next page)

Manure Management

(Continued from page 3)

hauling has the following shortcomings: poor equipment life due to frequent wetting and drying and associated corrosion; manure must be hauled during inclement weather; hauling on wet fields leads to soil compaction and ruts; success with this system is highly dependent upon seasonal land availability; and surface application leads to a high potential for pollution due to runoff.

Storage Alternatives

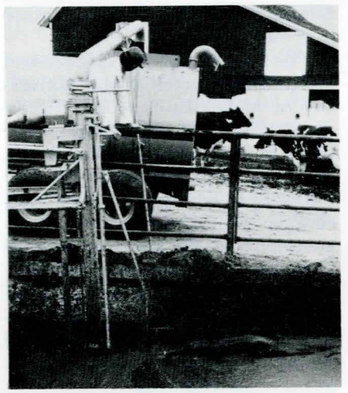
Once a decision is made to incorporate storage into the manure management program, it becomes essential to decide among the available storage options. With any type of storage all components of the manure handling system must be planned together. This includes equipment for movement of the manure from the barn, transfer to and from storage, and land application. Storages can be classified: 1) by the consistency of manure to be stored—bedded-pack, semi-solid, slurry and liquid; and 2) by the location of the storage relative to grade—above-ground (tower and tub silos), in-ground (pressure preservative treated plank, earthern bank, slotted dams and stacking areas), and under-ground (concrete tanks under a building or feedlot).

Manure consistency is important because it influences storage design, equipment required to get the manure into and out of storage, and land application equipment. The location of storages relative to grade influences the number of times manure is handled. Manure is generally pumped into and out of above-ground storages, whereas in-ground and underground storages utilize gravity for loading.

Bedded-pack manure usually has sizable quantities of bedding materials added. Handling can be accomplished with an open tine front-end loader and conventional box spreader.

Semi-solid manure might have a small amount of water or bedding added, but generally is manure in an "as produced" condition. A closed-bucket front-end loader is necessary for loading since the manure will flow through open tines. However, it will not flow rapidly enough for efficient pumping. The spreader might be either a box spreader with a hydraulic tailgate or an open tank-type unit.

Slurry manure has minimal amounts of bedding and controlled quantities of milking center effluent or roof water added for dilution. Slurries are fluid enough to be pumped with special solids-handling pumps and cannot be handled efficiently with a front-end loader. Since the manure is



Liquid manure handling systems afford greatest potential for conserving nutrients.

usually pumped into a closed tank-type spreader, bedding materials must be fine and minimized to allow such materials to be put into suspension for pumping.

Bedding materials must also be minimized for liquid systems. Large quantities of water are often added to the manure, making a highly flowable mixture. Sources of water might be milking center effluent, feedlot run-off, flush water, and roof water. Irrigation is usually the preferred land application technique since handling large quantities of water with a tank wagon is inefficient.

Table 1 compares various characteristics for different storage options. The importance of each must be carefully evaluated for each installation. Crop nutrient retention ability generally should not be a major factor in alternative selection criteria since, for manure storages having similar amounts of dilution water, the rate of nutrient loss is similar.

Duration of Storage

When planning a storage system consider the number of days storage needed in relation to availability of labor, equipment, and land. A 200-day (about 6 months) storage capacity is the minimum recommended. This normally eliminates the need to spread manure on frozen, snow-covered ground and reduces the risk of runoff and subsequent pollution as well as the risk of damaging equipment. The risk of accidents is also reduced since heavy loads are not handled on ice-covered fields and roads. A 200-day storage capacity will often eliminate the need to spread on wet, muddy fields during early spring as well. The result is reduced compaction and rut formation. Compaction can reduce yields and ruts may increase surface runoff and cause farmability problems.

Plan the storage for sufficient capacity to span the growing season.

With today's intensive cropping practices, many dairymen have no desirable place to spread manure from the time the last corn ground is plowed in the spring until the first silage is removed in the fall.

In all cases, in calculating storage capacity, allow for all substances which will enter the storage: manure, precipitation, runoff, bedding, milking center effluent, required dilution water, etc. Allowance also must be made for freeboard (additional, normally unused, depth for storm water storage) as required under both State and Federal regulations to minimize the risk of pollution.

Storage Cost

In planning a storage system, anticipate a minimum initial investment for the storage and equipment for land application of $8,000-10,000. Current prices for earthen bank storage are about

Table 1. Characteristics of commonly used manure management systems.

	Daily haul	Above-ground silo—tub or tower	Earthern pit	Roofed storage	Stackers	Underground concrete tank	Slotted dam
Manure handling consistency: Bedded-pack or semi-solid	X		X	X			X
Slurry		X	X		X	X	
Liquid		X	X		X	X	
Storage construction cost		High	Low	High	Mod.	High	Mod.
Storage land area requirements		Low	Mod.	Low	Mod.	Low	High
Storage loading options: Gravity			X	X		X	X
Conveyor			X	X	X		X
Pump (solids or large piston)		X	X				
Storage unloading options: Front-end loader			X	X	X		X
Gravity		X				X	
Pump		X	X	X	X	X	
Agitation required before storage unloading		Yes	Yes	No	No	Yes	No
System places limitations on types or coarseness of bedding	No	Yes	No	No	No	Yes	No
Spreader type (B=box, T=tank)	B,T	T	B,T	B	B,T	T	B
Is additional system or equipment required for management of milking center effluent, lot runoff, or precipitation?	Yes	No	No	Yes	Yes	No	No
Odor potential from storage unloading and land application	Low	Mod.	Mod.	Mod.	Mod.	High	Low
Work load distributed throughout year	Yes	No	No	Yes	No	No	Yes
Is hauling of precipitation required?	No	Yes	Yes	No	Yes	No	No
Easily expanded to accommodate larger herd	Yes	No	Yes	No	No	No	Yes
Use limited by shallow bedrock or high groundwater level	No	No	Maybe	No	No	Yes	Maybe
Daily labor requirements	High	Mod.	Low	Low	Low	Low	Low

10¢ per cubic foot as compared to concrete or steel storages which are about $1.00 per cubic foot. Construction costs for the storage itself will range from 20¢ to $2.00 per cow per day of storage depending upon the type of storage unit selected. Depreciation, annual operating costs, cash flow requirements, financing costs, taxes, and insurance are among other factors to be considered.

Safety

All storages have safety hazards. Included are: drowning; explosions due to methane; toxic gases, such as hydrogen sulfide; and irritants, such as ammonia. To help protect against these hazards:

1. Never smoke around a manure storage.
2. Never enter a manure storage tank or silo without an artificial air supply and someone outside the tank with a rescue line attached.
3. On underground storages, provide grates, covers, and protective fences or rails for all openings.
4. Provide a substantial woven or welded wire fence around in-ground storages.
5. On above-ground storages start access ladders above the reach of children.
6. Provide outward sloping fences around the top of above-ground storages to reduce the temptation by children to scale the wall.
7. Provide a ladder on the inside of all storages for emergency escape.
8. Provide a sign near the storage to alert and inform visitors regarding the presence of the storage.
9. Stored manure always contains toxic gases. These gases are released during agitation and pumping. Watch for signs of ill-effects in cattle or personnel during agitation and pumping operations. Discontinue these operations and ventilate building if ill-effects are observed.

Summary

Changes in a manure management system nearly always require a significant financial investment. Therefore, it is imperative that careful consideration be given to all available options before making a final decision or signing a contract.

The Midwest Plan Service "Livestock Waste Facilities Handbook" and "Dairy Housing and Equipment Handbook"—both available from Agricultural Engineering Extension at the University of Nebraska—discuss many of the factors and considerations mentioned and provide guidance for planning an overall manure management system. Visiting other farmers to observe and discuss their operation and system is highly recommended before finalizing plans.

Should You Breed Dairy Heifers to Non-Dairy Bulls

Dairy heifers must be bred to dairy bulls if optimum genetic improvement is to be realized.

Franklin Eldridge
Professor, Dairy Breeding

The average dairyman who is maintaining a relatively constant herd size will find that about a third of the calves born in his herd each year are born from first-calf heifers. This is assuming that the average age of milking cows is about 54 months, the calving interval is 13 months, and all cows and heifers are bred to dairy bulls. Therefore the female offspring from the first-calf heifers make up a sizable percentage of all replacement heifers entering the dairy herd.

The larger the number of heifers calving per year the greater the opportunity a dairyman has to cull inferior cows from his milking herd. A certain amount of culling is involuntary; that is, some cows develop serious cases of mastitis, do not breed, become injured, or die. In addition to these involuntary losses, the dairyman would like to replace his lower producing cows with higher producers. If he has a sufficient number of heifers ready to freshen he is in a position to replace the lower producers with heifers which have the potential for higher production. Of course, some of these heifers will produce milk at a level that is less than expected and will become candidates for culling during their first lactation.

Three in a Lifetime

The average age of cows in Nebraska dairy herds is less than five years. So, on the average, a cow will have approximately three calves in her lifetime. Half of those calves will be bulls, and about 80 percent of the calves born will live, breed, and enter the milking herd. Therefore, with the three calves born to the average cow there will be 1.2 replacement heifers entering the herd ($3 \times 0.5 \times 0.8 = 1.2$). To maintain herd size the average cow needs to provide one replacement heifer. This leaves only 0.2 of a calf per cow on the average available for selection for genetic improvement in the herd.

Genetic Potential

The genetic potential of the replacement heifers depends on the transmitting ability of their sires and the transmitting ability of the dams. Most of the genetic improvement of the herd comes through the sires because most of the female calves from a cow must be used as replacements just to maintain herd size with little opportunity for selection. By using artificial insemination the best sires in the country can be selected on their PD's for production and type and used on all cows in the herd.

There are many sires available through artificial insemination today which have predicted differences (PD's) above +800 lb (363 kg) of milk. This means that in the average herd of dairy cows the daughters of such bulls will average over 800 lb (363 kg) of milk more than their herd mates. If a dairyman has been using sires of this quality, the crop of replacement heifers will not only be capable of producing more than their dams, but they will also be capable of transmitting higher production to their own offspring. In other words, using AI bulls with PD's over +800 lb (363 kg) of milk will result in a group of replacement heifers which will be better dams than will be the older cows in the herd for the next generation of replacement heifers.

Production Increasing

The average production of dairy cattle in Nebraska has been increasing each year for many years. To remain competitive with other dairymen in the state the herd average must increase. Improving faster than other herds, which is every dairyman's goal, requires doing a better than average job in breeding the herd. With more replacement heifers from the herd, sired by bulls that are well above average, it is possible to increase production more rapidly than the average dairyman. Many of these bulls with high PD's for milk production also have plus (+) PD's for predicted differences for type. If improvement in type is part of the dairyman's goal, semen from such bulls can be purchased at reasonable prices.

It is widely recognized that the frequency of calving problems is higher in heifers than in cows. Therefore, it is to the advantage of a dairyman to breed heifers to sires which produce smaller calves to reduce these problems. The current interest of dairymen in cattle of greater stature may have added to this problem. This is because calves which have the potential for greater stature are frequently larger at birth. Information on calving ease is now available on many sires in each AI stud.

In the management of a herd of dairy cattle the dairyman may not have a corral or lot near the milking cows where he can conveniently keep breeding age heifers so that they can be observed daily for heat. For this reason the dairyman may decide to pasture-breed his heifers. Angus bulls are often used because calves sired by them are smaller and cause fewer calving difficulties. The consequences of this policy frequently are misunderstood.

Using the previously stated figures, breeding heifers to non-dairy bulls would result in fewer replacement dairy heifers. If a dairy cow averages three calves in her lifetime, and one of those is sired by a non-dairy bull, only two are available for replacements when cows are culled. Half of those calves are bulls, and only 80% of the heifers under good management will ever enter the milking herd. So, for every 10 milking cows, a dairyman has only 8 heifers to replace them. This leaves no possibility for selection on the basis of production, and means that the dairyman must keep milking cows in his herd to an older age just to maintain his present herd size. Furthermore, if he had bred his cows by AI to sires with PD's of +800 lb (363 kg) of milk or more these heifers are the best group of potential dams of more replacement heifers. Breeding the heifers to non-dairy bulls eliminates the possibility of utilizing this higher transmitting ability for the production of replacements.

Calving Ease

Most of the AI studs now have information on calving ease for many of their bulls. By selecting a sire with a high PD, which also has been found to be better than average in calving ease, one part of the problem can be eliminated. With this information there is no need to use an Angus bull to reduce calving problems. This procedure does require breeding the heifers artificially. Development of appropriate facilities may be required so that breeding age heifers can be observed daily for heat and penned where they can be bred artificially. The gain in returns can more than offset the costs of such a facility through improvement in herd production.

If breeding the heifers in the pasture seems to be the only feasible alternative, a young dairy sire should be used. Its sire and maternal grandsire should both have plus PD's and it should be from a high producing, good type dam. This is a better method for improving the breeding value and production of the cows than is the use of a non-dairy bull. This does not, however, eliminate the calving problems. It seems logical to assume that if the sire and maternal grandsire are noted for ease of calving, such a young bull would have a higher probability than the average for minimal calving problems. This assumption, however, needs more research.

Factors to Evaluate

Before a dairyman decides to breed his heifers to a non-dairy bull he should evaluate all the costs and returns. The factors to be considered are:

1. Compare prices of crossbred heifer calves with dairy heifers sired by high +PD dairy sires.
2. Compare prices of crossbred male calves with dairy bull calves sired by high +PD dairy sires.
3. Compare costs of breeding to high +PD dairy sires with records of above average calving ease with maintenance of a non-dairy sire.
4. Compare costs of a facility where breeding age heifers can be observed and bred artificially with the cost of maintaining pasture breeding.
5. Most important, recognize the loss of potential production of the herd which results from losing one-third of the heifer calves born per year, from the replacement heifers, and the loss from not utilizing those high production potential heifers as dams for the next generation.

In the final analysis, if a dairyman plans to stay in business, it is doubtful if he can justify breeding dairy heifers to non-dairy bulls.

Heat detection aids include the chin-ball marker, a chalk or paint marking stick, and mount detectors. To be useful they must accurately detect a large percentage of the cows in heat.

Heat Detection Aids

Larry L. Larson
Associate Professor, Dairy Physiology

One of the most serious problems in getting cows bred at the proper time is finding cows in heat. Studies across the country estimate that about 50% of the potential heat periods are being missed. Nebraska dairymen, in a recent survey, listed heat detection as their number one breeding problem.

Several heat detection aids that might help to catch cows in heat are commercially available but their efficiency and practical value need to be established. To be useful they must accurately detect a large percentage of the cows in heat.

Methods Compared

During the winter of 1977-1978 we compared four methods of detecting cows in heat: 1) visual observation, 2) mount detector, 3) chalk on tailhead and 4) testosterone treated cow fitted with a chin-ball marking device. Changes in progesterone levels in the milk

(Continued on next page)

Heat Detection Aids

(Continued from page 7)

were used to determine if the cows were actually in heat at the time indicated by one of the methods. If milk progesterone was low at the time of detected heat and elevated seven days later or if the cow was bred and conceived, a true heat was considered to have occurred. If the milk progesterone level was high at the time of the detected heat it was considered the cow was not in heat at the time she was marked or observed (false positive).

Results of this trial are given in Table 1. Of the four methods compared, mount detectors were the most efficient in detecting cows in heat but they also had the highest rate of false positives. Most of the false positives were thought to be caused by the cows activating the devices against free-stall dividers.

Close observation is required to determine which cows were marked accidently and which are actually in heat. Smearing of the chalk on the tailhead was successful when the chalk was fresh. However, after a couple of days during the cold winter months the chalk would freeze and dry out and would not rub off when the cow was mounted. Others have gotten very good results with using the chalk mark on the tailhead. But, the best results have been obtained in the warmer and drier regions of the country and when a fresh chalk mark can be applied each day.

Table 1. Accuracy and efficiency of detecting heat confirmed by milk progesterone levels.[a]

Method of detection (4-month period)	Efficiency of detection[b]	False positives[c]
Observed standing[d]	38%	11%
Mount detector	89%	31%
Chalk on tailhead	38%	11%
Testosterone treated marking cow	31%	0%

[a]Sixty-six heat periods (45 confirmed and 21 false positives).
[b]Percent of true heat periods (confirmed by milk progesterone) detected by each method.
[c]Percent of times the cows were not in heat when device said they were.
[d]Includes only cows actually observed standing to be mounted.

Testosterone treated cows fitted with a chin-ball marking device varied greatly in activity, causing the overall efficiency of the method to be low. Other researchers found testosterone treated cows very good at detecting cows in heat. The success of this method is determined primarily by the amount of activity and aggressiveness created in the marker cow by the testosterone treatments. If the testosterone stimulated cow is very active and the chin-ball device is properly managed, most cows in heat will be marked. Unfortunately, the activity of testosterone treated animals is quite variable.

Visual Observation Poor

The fact that only 38% of the cows were actually observed in standing heat is disturbing. This indicates that the observer relied too heavily on the heat detection aids or was identifying heat by visual symptoms other than standing to be mounted. It should be emphasized that only the cows actually observed standing to be mounted were included in this category. Also, these cows were confined to a concrete lot which at times was icy and slippery and sometimes frozen hard and rough. These conditions inhibit mounting activity. Other researchers estimate that about 50% of the heat periods in many dairy herds are missed.

Heat was first detected in the morning in 66% of the confirmed heat periods and in 76% of the false positive cases. Twelve of 28 cows bred at the confirmed heat period conceived, whereas none of 11 cows bred at the time of the false positives conceived.

Conclusions: Heat detection aids can help to detect cows in heat that might otherwise be missed. Use of these aids should not replace routine visual inspections of the animals for heat. Routine visual checking is required to: 1) detect cows in heat where the device failed, 2) to eliminate false positives and 3) to make sure that heat detection aids are in place and operating properly.

Calf Raising: Let's Keep It Simple

Foster G. Owen
Professor, Dairy Nutrition

Larry L. Larson
Associate Professor, Dairy Physiology

Calf raising represents a long term investment of feed, labor, and other costs as well as the dairyman's hope for a superior future herd. Goals for this enterprise are, first, to keep disease and death losses as low as possible, and, second, to avoid unnecessary costs and complex raising programs.

Since 1963 we have been experimenting with calf raising programs. One aspect was to extend the feeding of colostrum by saving the colostrum produced from the first six milkings and preserving it by freezing. In addition, we determined that health and performance of calves fed a liquid diet once daily was equal to those fed twice-daily. Results were also equally good when milk or colostrum was fed at a warm (32 to 38°C) or cold (2 to 7°C) temperature. In other experiments we learned that calves could be successfully weaned at 3 weeks of age, reducing the labor required for feeding compared to conventional systems in which calves are fed liquid diets until 6 to 10 weeks of age.

Table 1. Growth data.

	Standard Plan	Nebraska Plan
Birth weight[a], lb (kg)	91.2 (41.5)	91.2 (41.5)
Weight at 42 days[b], lb (kg)	134 (60.8)	126 (57.2)
Wither height at 42 days[b], in. (cm)	31.1 (78.9)	30.6 (77.6)
Weight at 56 days[b], lb (kg)	160 (72.6)	150 (68.1)
Weight at 6 mo., lb (kg)	351 (159)	344 (156)
Weight at 12 mo., lb (kg)	643 (292)	643 (292)
Weight at 18 mo., lb (kg)	813 (369)	821 (373)
Weight at 24 mo., lb (kg)	1,017 (462)	1,033 (469)
Weight at freshening, lb (kg)	1,146 (520)	1,166 (529)
Wither height at freshening, in. (cm)	53.7 (136.5)	53.7 (136.5)

[a]Adjusted to equal starting weights.
[b]Differences between treatments are statistically significant.

The experiment in this report is one in which we combined ideas from previous experiments into a single feeding plan (Nebraska Plan) and compared this plan with a more conventional plan (Standard Plan). All calves remained one day with their dams to obtain initial colostrum. From 2 days to 60 days of age calves were penned individually in a warm calf house. After 60 days of age, all calves were grouped by age and managed under a plan involving minimal housing and limited pasture.

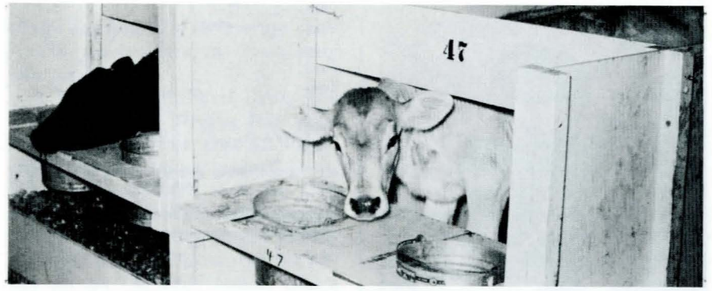
Standard Plan—Thirty-nine Holstein heifer calves were fed according to this plan. They received normal herd milk warmed to 32 to 38°C in two feedings daily of 3.5 lb (1.6 kg) each. They were abruptly weaned at 42 days of age.

Nebraska Plan—Forty-one Holstein calves were assigned to this plan. They were fed the colostrum produced the first 3 to 4 days after freshening. This colostrum was stored in a freezer and before feeding was thawed to 2 to 7°C. Calves were fed this cold colostrum once daily at the rate of 7 lb (3.2 kg) per feeding from day 2 until weaned at 21 days.

Calves on both plans received starter ration free-choice from birth to 60 days of age. At that time, calves from both plans were put together in common groups and were subjected to the same conditions of feeding, breeding, and management through the first lactation.

Effects on Growth

Data in Table 1 show that calves on the Standard Plan gained more weight and were taller at the withers at 42 days than calves on the Nebraska Plan. This difference, also seen in weights at 56 days, is probably due to the higher level of nutrient intake associated with continued milk feeding to 42 days of age. However, gains on both plans were satisfactory for calves of this age.



Early weaned calves need a palatable starter ration and fresh water available continuously.

By 6 months of age, gains were practically equal for the two groups and remained similar at 12 and 18 months of age. Thereafter, gains were slightly more for the Nebraska Plan calves. At calving time they averaged 20 lb (9 kg) heavier, but wither heights were identical. None of the growth measures at six months or beyond were significantly different.

Reproductive Performance

Data in Table 2 show that heifers on both feeding plans were practically equal in reproductive performance. Services per conception and percent heifers conceiving to two services averaged 1.46 and 93% and were similar for the two plans. Days open after first calving were higher for the Nebraska Plan, but analysis indicates this difference could have been due to random variation.

Milk production data (Table 2) were converted to mature equivalent to remove differences among age of heifers and make data more comparable. The more restrictive Nebraska Plan did not reduce milk or fat production. Lactation performance was actually slightly higher for the Nebraska Plan. Analysis showed, however, that these differences were not significant.

Table 2. Reproduction and milk yields[a].

	Standard Plan	Nebraska Plan
Services/conception	1.44	1.48
Conception to first service, %	61	62
Conception to second service, %	32	32
Days open	104	129
Days in milk	289	293
305 day milk yield[b], lb (kg)	13,644 (6,194)	14,056 (6,381)
305 day fat yield[b], lb (kg)	508 (231)	515 (234)

[a]None of these differences were significantly different.
[b]Mature equivalent yields.

Health

Losses of calves were similar for the two plans. Five of the 39 calves starting on the Standard Plan were lost during the experiment, two died as calves, one at 11 days and the other at 69 days of age. One died at calving, one was lost to mastitis (sold) and one died of unknown causes.

Six of the 41 calves on the Nebraska Plan were lost, three as calves before 12 days of age: one from Salmonella, one from scours at 3 days and one from an unknown cause(s). One was lost after two years from pneumonia before calving, two after calving, one from an injured back and one had dead twins and never recovered normalcy. The losses on both plans were similar and no detrimental effects on health could be related to the restricted plan.

Conclusion: A simplified calf starting plan involving feeding of excess colostrum once daily and weaning at three weeks of age was evaluated. This plan produced replacement heifers whose size, reproduction, and first lactation yields were equal to that for calves fed normal milk by the conventional twice daily method to 6 weeks of age. No noticeable detrimental effects of the more restrictive program were found.

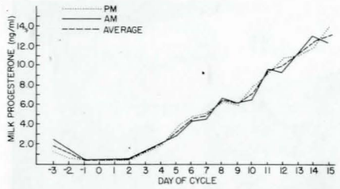


Figure 1. Changes in milk progesterone concentrations during the estrous cycle.

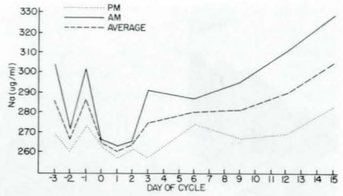


Figure 2. Effect of the stage of the estrous cycle on Na concentration of milk.

Changes in Milk Composition

Identifying Cows in Heat

Larry L. Larson
Associate Professor, Dairy Physiology

Identifying cows in heat so that they can be bred at the proper time is a major problem in many dairy herds. Contributing to this problem are: trends towards larger herds, increased milk production, confinement housing, less time spent observing individual animals, and other management changes. Since milk samples can be easily obtained twice daily at the time of milking, we decided to study a number of milk components to determine if they could be used to identify cows in heat.

The effect of the estrous cycle on milk composition was examined in 18 first lactation Holstein cows which were approximately 45 days postpartum at the start of the trial. Cows were milked into weigh jars so that the total amount of milk produced could be recorded and a uniform composite milk sample obtained. Composite milk samples were collected twice daily from each cow and analyzed for progesterone, fat, protein, total solids, sodium, potassium, magnesium, calcium and somatic cells (Wisconsin Mastitis Test).

Of the components examined only the changes in progesterone and sodium concentrations appeared to be specifically related to the stages of the reproductive cycle (Figures 1 and 2). The concentration of progesterone in the milk was minimal from 1 day before to 2 days after heat and then increased at a relatively constant rate through a 15-day period following heat. Since milk progesterone is low for several days around the time of heat, the best time to breed the cow could not be determined from a single sample. Although milk progesterone is being used for early pregnancy diagnosis, it is not a practical method for identifying cows in heat. This is because the assay for progesterone takes too long, is too complicated and requires highly technical equipment. However, this might become a practical method if a simple cow-side test for milk progesterone can be developed.

The concentration of sodium in the milk also changed during the estrous cycle (Figure 2). Unfortunately, the lowest value occurred on the day after the cow was in heat. A large drop in sodium did occur on the day of heat but additional studies are needed to determine if this is consistent enough to be of practical value.

All other milk components measured either did not change during the estrous cycle or varied too much to be of any value in identifying the day of heat.

Conclusions: Changes in milk progesterone levels are specifically related to the stage of the reproductive cycle. Milk progesterone levels drop drastically about three days before the next heat, are minimal from one day before to two days after heat and are high during the remainder of the cycle and during pregnancy. A simple cow-side test is needed to make its use in identifying cows in heat practical. No other milk component has been proven to be a dependable indicator of heat. However, sodium seems to have potential and needs additional study.

Will Forage Testing Pay Off?

Scott Hadden
Extension Assistant
Foster G. Owen
Professor, Dairy Nutrition

Forage testing costs dairymen in terms of sampling, packaging, mailing, equipment, charges for analyses, and time. How much return can they expect from all this effort and money?

To benefit from analyses the dairymen will have to use the information obtained. Usually this means utilizing this data in ration formulation. With our AGNET computer programs tailormade rations can be formulated to make full use of analyses of forages and grains as well as tag guarantees of supplements and minerals.

What are some ways forage analyses can be helpful?

Situation 1–You find you have 20% protein (DM basis) in your alfalfa hay which you previously had estimated to be about 16% protein, as a basis of ration formulation.

A ration was balanced using 16% protein value for alfalfa hay plus supplemental grain ration (corn-soy). Using current ingredient prices the cost was $2.96/cwt ($6.51/100 kg) for the total ration on as "as fed" basis. The same ration was reformulated using the same ingredient prices, but with the protein content of alfalfa hay changed to 20%. The ration cost was reduced to $2.60/cwt ($5.72/100 kg) on an "as fed" basis, or a savings of 36¢/cwt.

Daily cow consumption and ration price difference looks like this:

	lb consumed per cow/day	cost/ cwt	cost/ hd/day
Base ration 16% protein alfalfa	45.38 × $2.96=$1.34 (20.6 kg)		
20% protein alfalfa ration	45.44 × $2.60=$1.18 (20.6 kg)		

At least 15 cores, one per bale, should be taken of each lot of hay to assure a representative sample for analysis.

This leaves a price difference of $0.16 per cow per day. With a 100-cow herd the difference would be $16 per day, $480 a month and $5,840 a year! This shows that a simple forage test could save excessive feeding costs.

Smaller protein fluctuations would result in smaller savings differences, but the potential savings are phenomenal! In some cases your forage may actually be under "average" protein values. This is also wasteful and costly. It could result in decreased milk yield.

Situation 2. Your forage analysis shows a 13% protein content for your alfalfa hay instead of the average 16% protein you assumed in formulating your ration.

A ration formulated using the average (16%) alfalfa hay plus supplemental grain cost $2.96/cwt ($6.51/100 kg) on an "as fed" basis. When reformulated with the 13% protein value for alfalfa, using the same ration and ingredient prices, the cost was $3.21/cwt ($7.06/100 kg) on an "as fed" basis. When looking at daily intake, price difference looks like this:

	lb consumed per cow/day	cost/ cwt	cost/ hd/day
Base ration 16% protein alfalfa	45.38 × $2.96=$1.34 (20.6 kg)		
13% protein alfalfa ration	45.33 × $3.21=$1.46 (20.6 kg)		

This leaves a cost of 12¢ *more* per cow per day. Luckily this situation does not end here. We also know that if not reformulated, the ration would be short some nutrients and in this case the percent protein is deficient by 1.5 percentage units. One can approximate the decrease in milk production by utilizing this formula: [% protein deficiency × 1.5 lb (.68 kg) milk × 11¢/lb (24¢/kg) milk =_____¢].

In this case we would have 25¢/hd/day *loss* in decreased production. By paying 12¢ to reformulate you *save* 13¢/hd/day, $390/month or $4,680/year for a 100-cow herd! This shows that a simple forage test could save low production losses.

Table 1 summarizes the results of the examples plus an example of the effect of heat damage to hay. It is evident that forage testing, done properly, offers the opportunity for substantial increases in profits from dairying.

Table 1. Savings from forage testing and ration reformulation for a 100-cow herd.

% protein from analysis	Daily savings	Savings per month
Alfalfa hay mid-bloom (corn-soy + minerals)		
16% (average)	Base	Base
20%	$16.00	$ 480
13%	$13.00	$ 390
8%[a] (heat damaged)	$34.00	$1,020

[a]Protein value is adjusted downward for heat damage.

Quality Protein For the High Producer

Dr. Mary I. Poos
Research Associate

In recent years, emphasis has been placed on feeding high levels of energy and protein to the high producing cow to enable her to express her full genetic potential. As a cow produces more milk, it becomes less likely that she will be able to consume the quantities of feed necessary to support this production. It is therefore necessary to feed diets containing higher energy densities.

Research has shown that high energy diets, as well as high levels of intake, depress protein digestion. High producing cows can mobilize body fat to help supply the energy deficit in early lactation

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Quality Protein...

(Continued from page 11)

but body protein reserves are much less compared to energy reserves. In addition, the amount of protein required for milk production is much higher than that for maintenance and the high producer uses a higher proportion of her protein for milk. For these reasons, it is necessary to increase the protein percentage of the diet for high producing cows, particularly in early lactation. Research from many parts of the country has demonstrated that high producing cows can respond to levels of dietary protein up to 18 percent, but little attention has been given to the quality of protein needed in practical feeding situations.

Protein Quality

The quality of protein needed for high producers is, as yet, not well defined. We do know that it is necessary to increase the amount of true protein that reaches the small intestine and that this protein should have an amino acid make-up patterned to the requirements of the high producing cow. What this means is that the high producer needs to be fed protein sources which have both a good amino acid make-up and resistance to breakdown by bacteria in the rumen.

Some feed manufacturers, particularly in the Northeast, have begun to market dairy feeds on the basis of their soluble nitrogen content. While this is an improvement over the crude protein concept, it may be misleading, since solubility and ruminal breakdown (degradability) are not the same. For example, a protein supplement containing high levels of soybean meal would have a low soluble nitrogen content since soybean meal protein is only 10-15% soluble. However, soybean meal protein is 50-80% degraded in the rumen to NH_3 and volatile fatty acids. So the level of soluble nitrogen does not necessarily indicate the level of dietary protein that will escape degradation in the rumen.

Table 1. Effect of level of soluble nitrogen on daily milk production.

Crude protein in diet, %	Soluble nitrogen, %	Milk lb	Production, (kg)
12	(negative control)	64.5	(29.3)
16	13.5	68.0	(30.9)
16	39.8	70.6*	(32.1)*
16	44.5	66.0	(30.0)
16	48.2	67.1	(30.5)

*Significant greater than other treatments ($P<.05$).

A minimal level of soluble nitrogen is required in the dairy cow's diet for maximum microbial protein synthesis and maximum digestion of dietary fiber. Tables 1 and 2 show the effect of various levels of soluble nitrogen on milk production and fiber digestion in lactating dairy cows. Excessive levels of soluble nitrogen are excreted in the urine and provide no benefit to the cow. As milk production levels increase, the amount of protein synthesized in the rumen provides a correspondingly smaller percentage of the cow's total protein requirements. This means that the high producing cow requires even more ration protein of the type that will escape breakdown in the rumen.

Several experiments have demonstrated that usual levels of protein or protein quality (amino acid content) may limit milk production of high ability cows. In one study dairy cows receiving diets consisting of concentrates, silage, and hay containing 15 to 17% protein (dry basis) were given abomasal infusions of casein. This procedure prevented rumen breakdown of this high quality protein. Milk production increased by 2.2 to 8.8 lb per day (1-4 kg). This indicated that additional high quality, nondegraded protein is actually needed by the high ability cow.

Table 2. Effect of level of rumen ammonia on fiber digestion.

Crude protein in diet, %	Peak rumen NH_3 mg/100 ml	Acid detergent fiber digestibility, %
8.6	2.5	30.2
11.6	4.8	34.0
15.2	7.9	40.0
15.2	10.4	38.5
16.0	17.7	46.0
17.0	30.3	48.6

Decrease Protein Degradation

There are a number of ways to decrease rumen degradation of dietary protein. These include heat treatment or chemical treatment of the feed, addition of chemicals to the rumen to inhibit the enzymes that breakdown protein or feeding protein sources naturally resistant to microbial breakdown. Research at Northwest Missouri State demonstrated that when heat treated soybeans were compared to conventional soybean meal, cows fed the heated soybeans produced 3.2 to 5.2 lb (1.5 to 2.4 kg) more milk per day than cows fed the conventional soybean meal. Results indicated that the heat treatment of the soybeans may have protected the soy protein from breakdown in the rumen and caused the increase in milk production.

It would be economically beneficial to formulate protein supplements using urea to provide soluble nitrogen in the rumen in combination with protein sources that are naturally resistant to rumen breakdown, rather than to physically or chemically treat the more degradable protein sources. Recent research at the University of Nebraska with beef cattle and sheep demonstrated that combinations of less degradable protein sources and urea promoted greater weight gains than did soybean meal. Similar results have been obtained using a variety of the less degradable protein sources, including brewers dried grains, distillers grains, corn gluten meal, meat meal, blood meal and dehydrated alfalfa. When highly undegradable sources of protein or bypass proteins such as these are used, it is more important that some more-degradable nitrogen or nonprotein nitrogen sources such as urea be included to provide adequate NH_3-nitrogen for maximum microbial synthesis and fiber digestion.

Much of the research concerning the influence of feeding high bypass proteins on animal performance has been done using beef cattle and sheep. However, it is reasonable to expect that responses in dairy cows would be similar. In fact, even more of these undegradable protein sources would be expected to reach the abomasum of the dairy cow because of the higher levels of intake by dairy cattle compared to beef cattle and sheep. Table 3 shows the relative feeding value of certain high bypass proteins compared to soybean meal. As pointed out previously these protein sources may be even more valuable to the dairy cow due to the higher levels of intake required for milk production.

Table 3. Relative value of protein sources compared to soybean meal for growing steers.

Protein source	Feeding value (%)
Soybean meal	100
Blood meal	200
Meat meal	185
Corn gluten meal	200[a]
Soybean meal-bentonite	164
Distillers grain	173
Dehydrated alfalfa	190

[a]When fed with a high quality protein.

The goal in feeding the high producing cow is to provide optimum levels and ratios of amino acids for milk production in the most economical manner. This could ideally be done by formulating rations with nonprotein nitrogen for maximum microbial protein synthesis and high amounts of protein sources which resist rumen breakdown. Hopefully, research will evaluate this concept in experiments with high producing cows and confirm its merits.

Conclusion: For high ability cows to realize their potential for production, more attention will have to be given to meeting their protein requirements, especially in early lactation when intake is inadequate to meet needs of production. At this time protein requirements are up to 18% of ration dry matter. Consideration should also be given to including sources of protein which resist breakdown in the rumen and to the amino acid content of these proteins.

The AGNET program can provide dairymen with a CHECK-UP to evaluate the nutritional adequacy of their present feeding programs.

Computerized Rations Pay Off

Foster Owen
Professor, Dairy Nutrition
Scott Hadden
Extension Assistant

The AGNET FEEDMIX program for dairy rations provides several excellent opportunties to increase profits of Nebraska dairymen. The technology of computers and their operation is highly complicated and remote to most of us. But, the service it provides dairymen for ration formulation and evaluation is as close as the county extension agent or your telephone.

As the value of these programs becomes better known and appreciated more dairymen will realize even greater benefits.

Ration Evaluation Program

One of the computer programs is called RATION CHECK UP. This is used to determine whether a particular ration currently being fed by a dairyman is satisfactory. The computer will evaluate the ration by comparing its nutritional and physical qualities with those known to be required. We can learn if the ration has any deficiencies or excesses which might be harmful or wasteful.

Example 1. A dairyman's ration for his high producers is 1.5 percentage units below the required protein level. Otherwise, the ration appeared to be adequate for all other needs. What does this mean in terms of dollars and cents?

The loss in milk is about 1.5 lb (.68 kg) for each percentage unit of protein deficiency. If we assume 11¢ per pound (5¢ per kilogram) for milk, the dairyman is losing 25¢ per cow per day in income. To increase protein content of the ration by 1.5 percentage units costs 12¢ per cow per day based on current prices. This leaves a net daily increase of 13¢ per cow or $2,372 annually for a 50-cow herd.

Example 2. This ration is short on energy by an amount of 5 Mcal of estimated net energy (ENE) per 100 lb (45.4 kg). In other respects the ration is adquate. What amounts of loss does this cause?

For cows of high ability this 5 Mcal of ENE could amount to about 10 lb (4.54 kg) daily loss in milk yield. If milk price is 11¢ per pound (5¢ per kilogram) the loss in income is $1.10 per day for each cow. To reformulate and correct this deficiency the increased feed cost per cow would be about 20¢ per day. The net benefit then is 90¢ per cow daily.

Each of the illustrations are examples of only one deficiency. Many rations we have checked are deficient in several factors, while some have both deficiencies and excesses. Either of these situations may reduce net income of the herd.

(Continued on next page)

Computer Rations

(Continued from page 13)

Some other problems which can be detected with this procedure are:

1. Inadequate fiber, coarse roughage, and hay equivalent. This can result in fat test problems, and during long-term use the ration could produce an overfat condition and eventually a number of metabolic disorders.

2. Calcium-phosphorous levels and ratios. Adequacy of these minerals is essential for milk production and bone strength. Again, these minerals have long-term effects. Consequently, the monetary effect of a deficiency may not be seen for months and would be impossible to predict with accuracy. Nevertheless, attention to these minerals is necessary for minimizing milk fever and for normal reproduction as well as the above essential functions.

3. Deficiencies of vitamins. Dairymen are alerted to any deficiency of vitamins which may exist. Again, the value of correcting such problems cannot be accurately given, but we know we can't afford deficiencies.

4. Ration density. The computer can determine whether the ration has the desired bulkiness to maximize rate of intake for parlor-fed cows.

5. Undesirable feedstuffs. If the ration has one or more feeds which are less palatable, the computer will usually find these and indicate whether the level included is likely to be a problem.

The RATION CHECK UP program will help diagnose possible problems with a particular ration.

If there is a problem or deficiency in the ration, what can be done about it? This is the next step in the program. When asked, the computer will "correct" any ration not meeting the requirements. It will use the same set ingredients, if possible, and recalculate the amounts to properly meet the requirements. In some cases, additional feed ingredients are necessary.

In summary, when using the RATION CHECK UP program the dairyman will learn whether his present ration is sound. If it needs adjustment, he will learn what changes are needed and will receive a reformulation correcting any deficiencies or excesses.

Least-Cost Formulation Program

To get the most benefit from the computer, dairymen need to use the least-cost program. This program puts together a ration providing all the nutrients and quality specifications required for a sound, top quality ration at the lowest cost. The program is useful to dairymen for:

1. Selecting grains, whether for home mixing or mixing at a cooperative or commercial mill.

2. Deciding which supplement to purchase, when several are available from the same company or from different companies.

3. Selecting a forage program. The computer will help with this decision when a projection is made of certain other ingredient costs.

Selecting grains. The potential savings in selection of grain ration ingredients for least-cost formulation of grain rations is shown in Table 1. Prices used were those published by the USDA for grains and soybean meal for the months indicated.

This table shows the amount which might have been saved by least-cost formulation compared to mixing the usual corn-soybean meal-based ration. In December 1976, the saving would have been $31.60 per ton; in December 1977, $8.60; and, in November 1978, $9.20. When these savings are applied to a 50-cow herd they range from $1,075 to $3,900 or an average of over $2,000 per year.

For this illustration the grain ingredients, or primary energy sources, were limited to those generally available across much of Nebraska. At many locations through the state there are special locally available ingredients which would possibly make for additional savings. Generally, the greatest economic advantage is from local byproducts. Further savings, related to forages, are not considered in this example, but would add to the advantages of least-cost formulation.

Selection of a protein supplement. For this illustration several protein supplements are available, and the dairyman must decide which to buy. Any of these could be used to meet the nutritional requirements of a good ration, therefore, it is simply a matter of which will be most profitable. For these rations we used corn grain and enough oats and molasses to properly control density and dust. Supplements were:

1. 32% protein @ $175.00 per ton (.907 MT).
2. 40% protein @ $185.00 per ton (.907 MT).
3. 50% protein @ $200.00 per ton (.907 MT).

Ration ingredient costs were:

32%—$114.80/ton (.907 MT).
40%—$106.20/ton (.907 MT).
50%—$100.60/ton (.907 MT).

Between the highest and lowest cost rations the difference is $14.20 per ton (.907 MT). If a dairyman has a 50-cow herd and they eat 5,000 lb (2,270 kg) grain per head annually the savings would be $1,775 per year when using the computer only to select the protein supplement.

Selection of a roughage (forage). For this illustration let's assume a dairyman can produce either alfalfa hay or corn silage as his principal forage. He assumes that the alfalfa is average quality and costs of production are $32 per ton (.907 MT) for the hay and $20 per ton (.907 MT) for corn silage. He would like to know which will make the lowest cost ration for his herd and how much the difference would be.

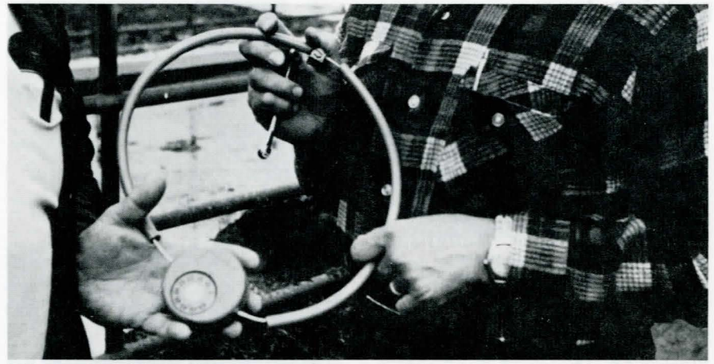
We assume prices for a grain and a supplement—corn at $1.96 for the grain and soybean meal at $240 per ton (.907 MT) for the high protein ingredient. With corn silage as the main roughage plus 6.5 lb (2.95 kg) alfalfa for dry roughage, the ration costs $4.51 per cwt (45.4 kg) of dry matter. This compares to $3.71 when alfalfa hay was used as the roughage. A major reason for the cost difference is the lower amount of soybean meal required to supply supplemental protein when alfalfa hay is used alone. At about 37 lb (16.8 kg) dry matter intake per cow daily, the savings would be [(37 lb × 80¢/cwt) (16.8 kg × 80¢/45.4 kg)] about 30¢ or $5,475 per year for a 50-cow herd.

Conclusion: The illustrations show how the computer can be profitably used by Nebraska dairymen to assure proper ration balance or to help them select ingredients to provide the most economical rations. Utilizing this tool can potentially save most dairymen thousands of dollars yearly.

Table 1. Savings in formulating grain rations by least-cost method.

	December 1976		December 1977		November 1978	
	Corn-Soy	Least-cost Ration	Corn-soy	Least-cost ration	Corn-soy	Least-cost ration
Corn	72.4	—	72.4	—	72.4	—
Oats	—	—		21.0	—	19.2
Milo	—	27.9		53.4	—	56.0
Wheat	—	49.7		—	—	—
Soybean meal	21.0	14.7	21.0	17.5	21.0	17.3
Molasses	2.4	4.23	2.4	3.95	2.40	3.91
Limestone	.87	.13	.87	.74	.87	.05
Dicalcium phosphate	2.37	2.35	2.37	2.46	2.37	2.45
TM salt	.65	.66	.65	.66	.65	.66
Vitamin A supplement	.28	.31	.28	.31	.28	.31
Cost/cwt (45.4 kg)	$ 6.83	$ 5.25	$ 5.24	$ 4.81	$ 5.68	$ 5.22
Savings with least-cost ration						
Per cwt (45.4 kg)	$ 1.58		$ .43		$ .46	
Per ton (.907 MT)	$ 31.60		$ 8.60		$ 9.20	
Annual per cow[a]	$ 79.00		$ 21.50		$ 23.00	
50-cow herd	$3,900.00		$1,075.00		$1,150.00	

[a]At 5000 lb/year (2,270 kg/year).



This "necklace" is actually a transponder worn by dairy cows to activate a feeder. It can be set to the exact amount of grain ration wanted in a 24-hour period.

Special Feeding Techniques

Don J. Kubik
District Dairy Specialist

This article presents an overview of old, new, common, and uncommon feeding techniques. It is meant to look at these techniques on the basis of their ability to increase your net income.

The first few techniques are important and necessary when evaluating and implementing more specific techniques discussed later.

Basic Techniques

A Total Feeding Program. The milking herd rightfully gets the most attention. To make feeding and management of the milking herd easier, special attention needs to be given the dry cow. The heifer raising program is also significant. Growing heifers out, getting them bred and into the herd at two years of age in good condition can mean real income potential. Look at the total feeding program for maximum production potential.

Meeting Cows' Needs. With the use of reliable feeding standards rations need to be balanced for at least energy, protein, fiber, calcium, and phosphorus. This can be done with a guide, by hand calculation, or with one of the computer ration programs now available. Today, with many feeds worthy of consideration in the dairy cow ration, plus the use of feed analysis, the computer is the only way to do a comprehensive balancing job.

Knowing All Forages. Most forages available have a book or table value. However, the best basis for ration formulation is sampling and testing your forages. There is enough difference in forages to make forage analysis profitable. In addition to the nutrient content of your forage a knowledge of the interaction of each feed with others is important. The characteristics of one forage may be entirely different when fed to dry cows as opposed to high producing cows. Also, an all-silage diet may have an altogether different effect on the milking herd after two years as compared to the first year. The effect may be greatly influenced by the dry cow program used in conjunction with the all-silage diet.

Sample and Save all Feeds. You are aware of freak feed contamination accidents in the feed industry and on the farm in recent years. Because of this, all feeds should be sampled and the samples saved long enough to know that they were not contaminated. This may be your only method of tracing a contaminated or a spoiled feed which may cause a problem in your herd.

More Specific Techniques

The more specific techniques

(Continued on next page)

Feeding Techniques

(Continued from page 15)

are divided into four categories: Selection, Preparing, Handling, and the actual Feeding.

Selection. There are several important considerations in selecting feeds to include in the ration:

1. High Quality Roughage. This has proven to be the most important element of any successful dairy feeding program. Alfalfa hay and corn silage are the primary roughages used in our area. Harvesting correctly is the key to high quality roughage, particularly alfalfa. Selecting the one, or combination of roughages, which fits your particular farming and storage capabilities is probably the best decision. In nearly all situations in our area, alfalfa yields the most dollars in the dairy ration. Each roughage should be analyzed and balanced with supplements for each group of cattle within your herd.

2. Other Forms of Common Feeds. Because of handling or storing situations unique to a particular operation other forms of available feeds might be considered. These include whole soybeans, high-moisture ear corn, high-moisture shell corn, flaked grain and roasted soybeans.

3. Other Feeds. Feeds which are not normally fed in your region, or are by-products of processing in your area, can sometimes be purchased economically and used to your advantage. Of a long list, a few might be hominy feed, brewers grains—wet or dry, beet pulp, cottonseed hulls, whey—wet or dry, barley, wheat mids and soy hulls.

4. Added Fiber. Some dairymen have done such a good job of producing and storing roughages that they may need a source of fiber in addition to the normal feeds to provide adequate fiber in the ration to maintain fat test. These may be found in low quality hay, straw, soy hulls, beet pulp, brewers grains, corn cobs, separated animal waste, corn stalks, or even cardboard. Used in correct amounts and blended properly these high fiber feeds may enhance a feed program.

This magnet feeder provides "extra" grain for selected cows. Only cows with this magnet can activate the feeder.

There are a number of easy ways to improve the roughage quality for the milking herd with the feeds available on your farm. One way is to let heifers or dry cows clean up the milk herds' feed bunks while these cows are being milked. Another method is to sort the feed on the farm and feed only the best to the cows. Use the lower quality portion of hay and silage supply for dry cows and heifers. It is necessary to limit intake of this group and such feed can be useful for this purpose. This means that an inventory of 120% of needs is often desirable.

5. Buying Right. Over-inventory should also be considered in times of cheap feed, such as a wet corn year, drought year for corn silage, or an over-production year for alfalfa. Don't forget contract purchases, booking ahead, and buying ahead as feeding techniques for improved net profit.

Preparing. To balance rations most effectively and most economically, consider:

1. Measuring. The most accurate is a stationary scale in the preparation center. Next, and nearly as accurate, is a scale on the feed wagon, or a platform to run the feed wagon across. Helpful, but less accurate, is a calibrated pressure gauge in the hydraulic line on the loader. A last method involves counting dumps which are periodically checked by weighing. For grain, a trip type measure and counter is quite accurate. When any system other than actual weighing is employed, periodic checks need to be made each time the type or source of feed is changed.

2. Adding to Silage. Many ration components are added to silage going into the silo to promote preservation or to simplify feeding. These include urea or ammonia, dry corn, wet corn (snap, ear or shelled), minerals, a total grain mix, whey, natural protein, wastelage, or others. Any or all of these may also be added when unloading the silo. These are added by layering, mixing in a mixer, using premixed, or top dressing.

Handling. Handling methods range from full automation to a pitch fork. Some techniques worth mentioning are: Shredding or grinding hay or straw, and use of a V-neck, slant bar, or stack feeder.

In feeding, try to expose only the minimum amount of silo surface to reduce feed deterioration. Don't hold feed on wagon overnight and keep bunks clean.

Of the feed supply, use only the best for the milking cows. Use any deteriorated or low quality feed in the rations of groups which do not need the number one quality feed. This may be separated out as in the case of the trench silo or may be identified by testing.

Feeding. Feeding cows has changed considerably in the last few years. From the usual grain feeding in the parlor have come various degrees of automation, feeding by milk flow, to computer allocation based on actual milk production regulated by electronic identification. A variety of techniques are available to get extra grain consumption to supplement that consumed in the parlor during milking.

Other methods include lock-in stanchions so cows can be locked in and fed extra grain individually. One inexpensive, but time consuming, method employed is sorting the high cows into a separate lot where they are fed extra grain. Cows adapt to the routine quickly, but breaking the habit is not so easy. When cows are grouped they can be placed in a grain feeding lot for a fixed period of time, depending on the level of production.

Some other practices recommended to improve palatability and intake rate when parlor feeding include: pelleting, adding fat or molasses, using high moisture grain, and providing outside self-feeders for some or all cows.

There are a number of feeders which allow individual grain feeding outside the parlor. With one type a key or magnet is placed on selected cows. It activates a gate, door, or motor to allow a cow access to grain from a self-feeder. Another device utilizes a transponder which is placed on the cow. This permits a setting for every cow so that she can be given exactly the grain desired. Some other more common techniques are: artificially increasing the hours of light, multiple feedings, location of waterers, cleaning bunks often, feeding only fresh feed, providing shade, and mechanical cooling.

Perhaps the biggest change from conventional feeding is the total ration concept. This is where all ingredients are mixed and fed as a single feed. This perhaps offers the best way of insuring accurate intake of the necessary nutrients by every cow. Another trend is back to tie stalls or flat barns which provides the opportunity for individual feed control and observation.

With total ration feeding, dividing and handling cows as groups becomes important. The most important consideration is to get the dry cows separated from the milking herd. For the milking herd three or four production lots are recommended, with cows moved each month on the basis of production and condition.

Controlling Somatic Cells in Milk

The Wisconsin Mastitis Test is used to measure somatic cells of milk.

Stan Wallen
Extension Food Technologist

Mastitis is an infection of the mammary gland which causes physical and chemical changes in the milk. One of these changes is an increase in the somatic cell count. An increased incidence of udder infections is directly related to increased somatic cell count.

As somatic cell counts increase, the production of milk in a herd decreases dramatically (Table 1). *The average dollar loss caused by mastitis was $161 per cow in 1977* (Table 2). Recent loss estimates range up to $250 per cow per year. Subclinical mastitis reduced the total production of milk in Nebraska in 1977 by about 161 million lb (73 million kg). Nationally, the total annual financial loss to dairy producers due to mastitis has been estimated at $1.3 billion. Obviously, money invested in proven programs to prevent or treat mastitis can return high dividends. It has been estimated that *for every dollar invested in a complete mastitis control program the dairy farmer receives $5 in return.*

The widespread occurrence of mastitis has been demonstrated in recent herd surveys; approximately 50% of the cows in most milking herds have udder infections, although only 3% of cows in an average herd have clinical mastitis. Due to swelling and the appearance of visually abnormal milk, clinical mastitis is easily recognized. Easy recognition of clinical mastitis makes its treatment routine. Unfortunately, mastitis occurs most often in a subclinical form and cannot be detected visually. Evenso, it causes an average 12% loss in milk production.

New regulations affecting the marketability of milk containing high numbers of somatic cells will go into effect in 1980. These regulations will affect producers of both Grade A and manufacturing milk who violate the somatic cell standard of 1,500,000 somatic cells per ml in three of the last five samples taken. In the past, producers of Grade A milk who violated this standard could market their milk as manufacturing milk; producers of manufacturing milk

(Continued on next page)

Table 1. The relation between quarter infections, lost milk production, and herd average somatic cell counts.

Average somatic cell count (000's)	Lost milk production (%)	Quarters infected (%)
200	—	—
300	1.4	3.0
400	3.6	7.7
500	5.9	12.4
600	8.1	17.1
700	10.3	21.8
800	12.6	26.5
900	14.8	31.2
1,000	17.0	35.9
1,500	28.1	59.3

Table 2. Estimated annual losses from mastitis in the United States (1976)[a].

Item	Average losses per cow ($)	Total national losses (millions) ($)	Percent of total (%)
Decreased milk production	82.63	897	62.0
Increased replacement costs	15.54	103	11.7
Discarded milk	15.31	142	11.5
Decreased sale value of cows	11.62	63	8.7
Drug expenses	4.15	42	3.1
Veterinary fees	2.28	22	1.7
Increased labor	1.82	25	1.4
Total	$133.35	$1,294	100.0%

[a]USDA

Somatic Cells

(Continued from page 17)

who produced milk containing more than 1,500,000 somatic cells per ml could continue to market their milk. When the new regulations come into effect in 1980, neither Grade A nor manufacturing milk producers will be able to market their milk when they violate the somatic cell standard.

Because mastitis is so widespread and so costly and because new regulations will soon impact on dairy producers who consistently produce milk containing high numbers of somatic cells, information about the infection process and its control should be valuable.

The Infection Process

Pathogenic bacteria which cause mastitis normally occur on the teat. Occasionally, these bacteria enter the udder through the teat canal. Once inside, these pathogens multiply rapidly on the lining of the milk duct or in the secretory tissue within one quarter. The infection usually does not spread to other quarters within the mammary gland because of the connective tissue separating each quarter. The cow responds to bacterial toxins and injured secretory cells by sending leucocytes (a type of somatic cell) to the site of the infection. When the leucocytes encounter bacteria, they engulf and destroy them.

Leucocytes flood the site of the infection until most of the infecting organisms have been destroyed. Usually, high leucocyte numbers will remain 7-10 days after the pathogen has been eliminated from the udder.

Somatic cells are produced by the cow in response to the infection of udder tissue by pathogenic bacteria. The somatic cells include leucocytes (white blood cells) and epithelial cells sloughed from secretory tissue. During mastitis, most of the leucocytes present in the milk are polymorphonuclear (PMN) leucocytes formed in the bone marrow and carried by the blood to the site of infection. A large number of somatic cells present in milk indicates bacterial infection, mammary tissue injury, and possibly a permanent reduction of a cow's milk-producing potential.

Sources of Pathogenic Bacteria

1. *The dirt-manure cow lot* is the most frequently encountered herd problem associated with mastitis. Soil and manure serve as a home to pathogenic bacteria, as well as an excellent transfer medium to the teats of healthy cows.

2. *Cows currently suffering from mastitis* are a bountiful source of pathogenic organisms which can be transferred to healthy cows via the milker's hands, dirty wash rags, the milking machines, or contact with common objects in the environment.

3. *Unsanitary teats* that are covered with milk and mud or manure provide an excellent growth medium in which pathogenic bacteria can multiply at the teat opening. The probability of udder infection increases as the number of bacteria on the teat increases.

4. *Improperly cleaned or maintained milking equipment* also provides an environment in which pathogenic bacteria can grow and ultimately contaminate all of the cows that come in contact with it.

5. *The milker* himself (herself) may carry bacteria that can cause mastitis. An infection on the hand represents a likely source of bacteria capable of causing an udder infection.

6. *Large variations in milking line vacuum* may actually allow milk to surge back into the udder. If the milk is contaminated with pathogenic bacteria, mastitis may result.

7. *Wash cloths and sponges* can carry pathogenic bacteria from one cow to another, resulting in an increased incidence of mastitis.

How to Prevent Mastitis

1. Provide a clean environment for the cows; eliminate or avoid muddy lots. Provide ample *dry* bedding. Remove objects from the cow's environment which could injure the udder.

2. Wash hands with sanitizing soap before milking and at intervals during milking as required. Avoid contact with the udder when a hand is infected. If necessary, wear disposable rubber gloves.

3. Wash, sanitize and dry teats with *single service towels* before milking.

4. Properly clean and sanitize milking equipment.

5. Maintain milking equipment, i.e., check vacuum levels, replace inflations, etc. Have the entire milking system serviced routinely by a qualified milking machine service man.

6. Prevent injury to the udder caused by: a) excessive milking line vacuum, b) large variation in milking line vacuum, and c) overmilking.

7. Milk cows having clinical mastitis last to prevent cross-contamination of healthy cows.

8. Use teat dip after milking. Recent studies indicate that teat dips containing iodophors, sodium hypochlorite, and sodium dichloro-s-triazenetrione are effective in destroying the most common types of mastitis-causing bacteria. Also, the use of teat dips one week before freshening and one week after drying off is highly recommended.

How to Detect Mastitis

1. Remove two or three streams of foremilk from each quarter and observe for abnormalities. Also palpate udders.

Table 3. Mastitis status in one herd, as indicated by the somatic cell analysis of individual cow milk samples, after implementation of a mastitis prevention program.

	Month of test			
Somatic cell count	June	July	Aug.	Sept.
Under 150,000 (%)	32.1	39.4	36.3	41.9
151-400,000 (%)	10.7	12.1	18.2	19.4
401-800,000 (%)	3.6	21.2	21.2	19.4
801-1,500,000 (%)	10.7	15.2	18.2	12.9
Over 1,500,000	42.9	12.1	6.1	6.4
Herd average (000)	1,869	685	475	461
Lost milk (%)	39	10	5	5
Quarters infected (%)	76	21	11	11

2. Test individual quarter milk for somatic cells. Table 3 shows the results that can be achieved by implementing a mastitis prevention program. Cows with cell counts over one million cells, excluding samples taken the first or last two weeks of lactation, can be considered infected cows.

3. Maintain herd and individual cow records of somatic cell counts.

4. Monitor the somatic cell count of the bulk milk supply.

How to Cure Existing Infections

1. Dry cow treatment with antibiotics is considered the best approach. Any cow with one or more cell counts over 400,000 during lactation or with a history of abnormal milk or clinical mastitis should be considered for dry treatment. Persistent high cell count cows may benefit by milking out and repeating the dry treatment seven days after initial treatment. For dairymen who do not keep records of cell counts on individual cows, the administration of antibiotics to all quarters of all cows between lactations is recommended. In general, the combined use of teat dips and dry cow treatment over a three year period reduces incidence of mastitis by 75%.

2. Consult veterinarian to determine proper treatment of cows having clinical mastitis.

3. Cull cows having chronic incurable cases of mastitis.

Regulations and Somatic Cells

The Nebraska Manufacturing Milk Act of 1969 states the following with regard to the testing of manufacturing milk for somatic cells; "A *Wisconsin Mastitis Test* (WMT) or *comparable test* approved by the Department shall be conducted *monthly* on a sample of herd milk from each producer and the producer informed of the results of each test.

"When results of any such test indicate the presence of 1,500,000 or more leucocytes per ml, the producer shall be sent a *warning letter* in which shall be *listed the principal causes* of excess leucocyte counts. Following the *second consecutive* indicating test showing a count of 1,500,000 or more per ml, an inspection shall be made by a *licensed fieldman* and assistance offered to help correct the cause". These regulations for manufacturing grade milk will be the same as existing regulations for Grade A or B milk.

Regulations for Grade A milk state that "whenever the somatic cell count exceeds 1.5 million, the dairy plant is expected to send written notice to the producer. When two of the last four counts exceed that level, the written notice must come from the regulatory agency. The last notice remains in effect as long as two of the last four tests remain above 1.5 million in count. At the same time an inspection is required, also by the regulatory agency, and at some time between the third and fourteenth day following this inspection, a sample of milk is taken for further analysis. If this sample proves excessively high in cell count (over 1.5 million), action will be taken to suspend a producer's certificate to sell milk".

Past experience with the grade A abnormal milk control program indicates that a relatively small number of dairy farmers will find themselves in violation of the 1.5 million standard once, and far more rarely two out of four times during a six month period. Nonetheless, some dairymen will be affected and the program should serve to identify these persons and to get assistance to them.

In essence, what the new regulation means is that producers of manufacturing milk could have their certificate to sell milk suspended if the somatic cell count of their milk is in violation. In the past, a producer of manufacturing milk could not have his certificate to sell milk suspended if he produced abnormal milk.

Another ramification of the new regulation is that Grade A or B milk producers who are suspended for producing abnormal milk will not be able to market their milk as manufacturing milk. If a milk producer is suspended for producing abnormal milk, he has lost his market as there is no place he can go to sell his milk.

DHIA Records: Management Tool

Philip H. Cole
Extension Dairyman

DHIA records have provided the dairyman important basic information needed to manage his herd profitably. Production records have provided him with a guide for: (1) feeding, (2) effectively culling and (3) selecting top animals to use in his breeding program.

Today's dairy operations are larger and more complex and the dairyman needs more sophisticated information to properly manage his herd.

Feeding and Cost

Today's DHIA records provide the dairyman with specific information about his herd's feeding program. For example, the concentrate (grain mixture) needed for each individual cow is determined on the basis of the cow's milk and fat production, her body weight, her age, her gestation status and the kind and quality of forages she is receiving. The program also advises the dairyman of the protein level needed in the grain ration.

By combining feed cost information and income from sale of milk the computer can tell the dairyman the income over feed cost for (1) each individual cow on a daily and a lactation basis and (2) for the herd on a monthly and annual basis.

Income over feed cost figures on the individual cow provides one basis for culling. The daily income over feed costs helps decide when to cull.

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DHIA Records

(Continued from page 19)

The herd Cost and Returns Summary (Table 1) gives the dairyman an economic picture of his overall operation. This summary provides forage costs, grain costs, total feed costs, value of production and income over feed costs on a per cow and on a per herd basis, for the test day and for the past 12 months. On a herd basis feed costs per hundred weight, returns per dollar of feed cost and milk price per hundred weight are listed.

Production Information

Each month every cow in the herd is ranked on the basis of Mature Equivalent (predicted potential) and a Herdmate Comparison. The Mature Equivalent (ME) simply tells the dairyman what kind of production he can expect from a particular mature (6-7 years old) animal, based on what large numbers of other animals of the same breed and the same age have done. It is the basic measurement from which her genetic potential for production can be estimated. The difference from herdmates tells the dairyman how well or poorly a particular cow is doing compared with other cows in his herd that have the same opportunity. Since this is an in-herd comparison it is a critical one and also a fair one. With these two comparisons available to him every month, the dairyman has another very accurate culling aid.

Once a year the dairyman has all of his cows ranked on the basis of their EPA (Estimated Producing Ability) and their EATA (Estimated Average Transmitting Ability). The EPA is based upon the difference from herdmates and the number of lactations. Using a cow's completed records it is the best estimate of how much her next record will differ from herdmates. By comparing each cow's EPA with each of the other cows a dairyman can quickly and accurately estimate which cows will be most likely to produce greater income next year. Cows with a low EPA become candidates for culling.

The EATA on the other hand provides the dairyman with a look at the estimated producing ability of offspring which will be his future replacements. Cows with the ability to transmit high production (have a high EATA) to their offspring are the most valuable animals in establishing a high future herd production. In the case of a newly established herd it is important to locate the cows with a high EATA value as quickly as possible.

Both EPA of a herd and EATA are important to the dairyman who is trying to make a living today and wants to continue in the future.

The Annual Herd Ranking and Summary also provides the dairyman with a comparison of his overall management with that of other herds of the same breed. A measure of the effectiveness of his culling program is also provided.

Reproduction

On a monthly basis the dairyman is provided with the following information about each cow: (1) days dry, (2) due date and (3) a pregnancy record. He is also reminded (1) when cows should be dried off, (2) when cows should be ready to breed following calving and (3) when cows should be checked for pregnancy.

On a herd basis the dairyman receives a Reproduction Summary, (Table 2) every month. This summary gives him: (1) the number of animals pregnant, (2) the number possibly pregnant and (3) the number open. He also receives a record of total animals bred, total number of services and average service per conception. For dairymen who wish an even more detailed reproductive summary there is the Repro Program. This program provides the dairyman with a very detailed analysis of his entire breeding program.

A new feature of the Herd Summary form is the Lactation Summary (Table 3). This evaluation compares first, second, third and fourth (and over) lactation animals. If first lactation animals are not equal or superior to later lactation groups this is a signal to the dairyman that he needs to (1) improve the selection of herd sires, (2) adjust his management procedures, or (3) begin to cull first lactation animals more closely.

Before the dairyman begins to cull first lactation animals too closely he needs to take a critical look at his management of these animals. Do first lactation animals in his herd really have an equal opportunity to produce well? Do his first calf heifers receive extra grain so that they can continue to grow as well as produce? Would these animals be more likely to get their share of the forages if they were housed and fed separately from the older animals in the herd? In larger herds it helps to keep 2-year-olds together.

If a dairyman determines that his first lactation animals have had an equal opportunity to produce and haven't done well then he needs to consider seriously culling them more closely, and review his sire selection policies.

In addition to all of the above listed information the dairyman may also subscribe to several special herd management options such as listings of cows to: (1) breed, (2) dry, (3) calve, (4) pregnancy check and (5) a list of low cows. Another special option is a listing of cows to cull. Each of these listings come on a separate form (Table 4) so it is possible for several different individuals to use this information at the same time. For example, the individual responsible for handling fresh cows might use the cows to calve list, the milker (s) use the cows to go dry list, the veterinarian uses the cows to pregnancy check list and the herdsman the low cow and cull lists.

Summary: It is difficult to run a business if there are no facts on which to make decisions. If a dairyman is to cull the right animal, feed a cow for maximum production and income, and improve the genetic basis of his herd he must have facts. The modern DHIA program provides the dairyman with production data he needs to make these decisions. In the near future DHIA figures may be able to be combined with other economic evaluations that will give dairymen information they need to manage their total farm operation.

Table 1. A comparison of cost and returns on a per cow and a per herd basis.

	$ Per cow		$ Per herd	
	Sample Day	365 Days	Sample Day	365 Days
Forage cost	.54	288	19	9,210
Grain cost	.80	271	28	8,667
Total feed cost	1.34	559	47	17,877
Value of production	3.69	1,421	129	45,474
Income over feed cost	2.35	862	82	27,597
Feed cost per cwt. milk			3.30	3.61
Return per $1 feed cost			2.76	2.54
Milk price per cwt.			9.10	9.17

Table 2. An evaluation of the factors that determine the reproductive efficiency of a herd.

	Replacement	Producing females		No. of animals open			Avg.	No. of animals bred			Days to	Breeding interval			Days minimum
Group	females	number	avg. days since fresh	<60 days	60 120 days	>120 days	days open	once	twice	3+ times	first bred	<18 days	18 24 days	>24 days	freshening interval
Pregnant	4	15	296		10	5	107	2 9	2 5	1	97	1	1 4	1 1	386
Possibly pregnant	4	8	152	1	7		92	3 5	1 2	1	79		1 1	2	371
Open	23	12	70	9	1	2	70	Total animals: Total services:			19 28		Average services per conception:		1.5

Table 3. A comparison of first lactation animals with other animals in the herd.

Lact. No.	305-2X-M.E. Milk	305-2X-M.E. Fat	Differences from herdmates Milk	Differences from herdmates Fat
1	15,921	502	+ 446	−44
2	17,066	562	+1613	+15
3	17,683	637	+1888	+75
4+	18,653	638	+3075	+81
Avg.	17,170	550	+1628	+23

HERD OPTIONS CAN HELP YOU MAKE MANAGEMENT DECISIONS

MANAGEMENT LISTS

COWS TO BREED

A complete listing of cows to breed.
1. Barn name
2. Days open
3. 45th day after freshening
4. Space to record heat date

COWS TO CALVE

A list of cows due to calve.
1. Barn name
2. Due date
3. Date calved

COWS TO PREGNANCY CHECK

A listing of cows to be pregnancy checked.
1. Barn name
2. Date bred
3. Days since bred
4. 42nd day after breeding

LOW COW LIST

A listing of cows that are considerably below herdmates in production. You choose basis of comparison and cut-off level. Basis of comparison includes 305-2x-ME, difference from herdmates, income over feed cost, or daily milk weight.
1. Barn name
2. 305-2x-ME
3. Difference from herdmates
4. Income/feed cost
5. Daily milk production

COWS TO DRY

A listing of cows to be dried-off to allow adequate dry period (45 days)
1. Barn name
2. Due date
3. Lbs. milk on last test date

Management lists available for 2¢/cow/month.

CULLING GUIDE

A list of potential cull cows based on production information. Your inputs give accurate costs in your situation.
1. Barn name
2. Daily profit
3. Profit till due
4. Projected dollar difference from herdmates next lactation
5. Total dollars

Culling Guide available for 1¢/cow/month

DHIA RECORDS— YOUR GUIDE TO HERD IMPROVEMENT AND HIGHER PROFITS

Table 4. These optional lists are available through DHIA to help dairymen make management decisions.

Calf Hutches Are for the Calf—Not You

Foster G. Owen
Professor, Dairy Nutrition

"Put a baby calf out in zero weather?" It just doesn't seem the humane thing to do. Besides, most dairymen find doing the feeding, bedding and other chores out-of-doors far from appealing during Nebraska's winters. Others are not sure the calf can tolerate the cold conditions without ill effects. These are some of the main objections dairymen have against the use of hutches. However, the critical question that must be answered is "what is the major objective of the calf housing system"? Is it for the workers comfort and aesthetics? Or is it for calf health and survival?

The hutch is for the *calf*! Its increase in popularity is because it has brought an end to severe disease problems and heavy calf death losses on many farms. The simple, outside calf hutch now ranks number one among all calf housing systems. The basis for this ranking is its record of lowest death losses and disease problems. Fortunately, it also is the least expensive housing system for calves now in use.

In this article we will look at evidence for success of hutch management and ideas on reducing the undesirable features of caring for calves in hutches.

Reduced Health Problems

Dairy calf losses are about 16 to 20% in all types of housing. Losses of one-third of the calves born is not uncommon on many farms. However, death losses reported on calves raised in hutches generally

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Calf Hutches

(Continued from page 21)

range between 5 and 10%.

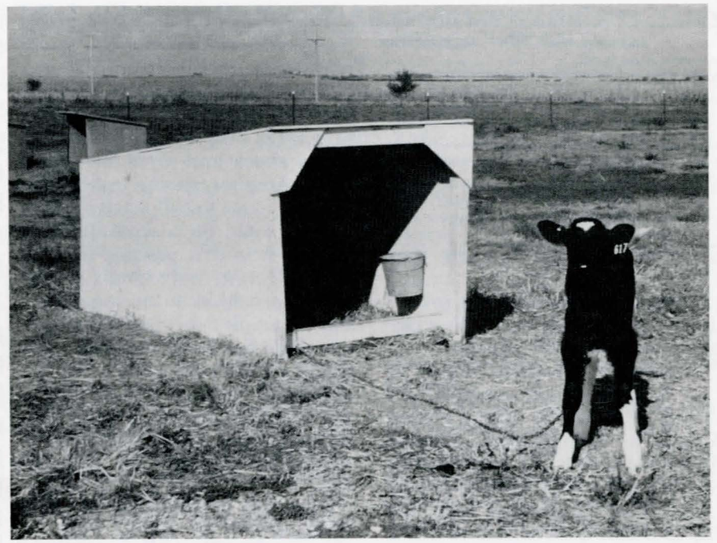
Over a 15-year period, South Dakota State University raised nearly 400 calves in outside hutches. They lost only 8.6% of these calves. About half their losses were during the first week. A sudden drop in temperature of 15° to 20°F (−9° to −7°C) or more was associated with about 50% of the losses. They found best weight gains between 30° and 60°F (−1° and −16°C . Even at 0° to 10°F (−18° to −12°C) gains were .32 kg/day (.7 lb/day) during the period from birth to four weeks of age. This is well above the .23 kg/day (.5 lb/day) generally accepted as satisfactory.

Performance of these calves as mature animals was examined to determine if those born during the cold months were at any disadvantage compared to those born in warmer periods. As yearlings, calves were of similar size, and as two-year-olds, there was no difference in milk production.

In our research at Mead we have used outside houses continuously since 1977. During this period we have lost 4 of 107 calves born. Before this we used the outside huts mainly between April and November. During a major experiment during this period we lost only 1 of 48 calves started. Those diseases which are common for young calves in confinement housing, mainly diarrhea and pneumonia, have been practically eliminated in calves in outside type houses.

Most dairymen now using hutches shifted from indoor systems where disease and death losses were excessive. *Hoards Dairyman* magazine published a story of four such herds involving 333 calves. In hutches they raised 316 or 95% of these calves. Included were Brown Swiss, Guernsey, and Holstein herds located in Minnesota, Wisconsin, New Hampshire and Georgia.

Experimental comparisons have been made between inside and outside housing at various places



Calf hutches are simple to build and are the lowest cost method of housing calves recommended.

including South Dakota, Indiana, Wisconsin, and Florida. No advantages were noted in calf performance or health from raising calves inside.

Other Advantages of Hutches

Certainly, the major reason for hutches is their value to calf health and survival of young calves. However, they have other important advantages compared to inside type housing.

Lower cost to build and own. Good hutches can be built of plywood for about $75 to $100 each depending on whether you include an outside run or use a chain and collar. Prefabricated houses may cost up to $300.

Low-cost operation. Hutches use no energy for heat or ventilation. A conventional warm calf house would likely use electric power for fans and lights and natural gas for heat.

Flexible. Hutches can easily be moved to a better site on the farm or even to another farm. When calf numbers increase, it is more feasible to simply build additional hutches than to expand a more permanent structure.

Less bedding and cleaning. Compared with indoor bedded pens, calves outside may require less bedding and time for bedding, because the area is usually greater for the outside calf. Compared to most indoor systems, outdoor houses require little clean-out time. This is a particular advantage with systems involving frequent movement of these houses.

Management Requirements

1. Build or purchase a substantial building that will withstand the stresses of frequent movement and will resist strong winds.

2. Locate hutches on a well drained area. Several inches of gravel or sand often improve the base. Face them to the south in winter and to the east in the summer.

3. Get the calf into the hutch as soon as its had one days colostrum. During the first day calves should either be outside with their dam or in a cold type (unheated) building. Do not transfer them from a heated building to the outside during the colder months.

4. Assure ample feed energy intake during cold periods. Delay weaning during extremely cold weather.

5. Bed well with straw or shavings in winter and as often as needed to keep dry during rainy periods.

6. Clean (sanitize) periodically or before starting another calf. Turn over, or set on end to allow exposure of the inside to sunlight following sanitizing to aid in disinfecting. Move the hutch to a new area at least two or three times yearly.

Making Hutches More Acceptable

Among problems with use of hutches seems to be the necessity of the caretaker being outside during disagreeable weather, the distribution of feed, water, and bedding to the many hutch locations, and freezing of water in winter. Here are some ideas for reducing these problems.

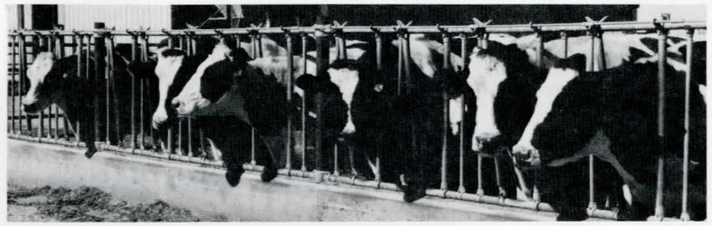
1. Locate the huts in the winter on the south side of a building or windbreak (check to assure they are not in the path of a draft).

2. As winter approaches put the hutches under a shed or other "cold" buildings.

3. If you have a conventional calf building, you may shift to using it during December through February. This provides an opportunity to completely clean each of these facilities when vacated and will help break any disease cycle or build-up.

4. To speed chores, a low bed wagon, trailer, or cart seems ideal to take water, milk, starter feed and other supplies to the hutch area. South Dakota researchers found no appreciable difference in the amount of time required to care for calves in hutches and calves inside a conventional house. However, more careful planning of choring procedures is needed with hutches. For example, in very cold weather watering calves once or twice daily, then dumping remaining water, will avoid ice problems.

Conclusion: Although calf huts are not for *me*, for the *calf* they offer the best prospects for good health and survival. Dairymen should consider hutches, especially if their losses are greater than 10% under their present housing system. Those who do not want to shift to hutches year-round might consider using them at least during the warm months.



Research is being conducted on group feeding of complete mixed rations.

Research Progress Reports

Metabolic Profiles: (Larry L. Larson)

Blood samples were collected over a 12-month period from 115 early postpartum dairy cows to determine the relationship between blood composition and reproduction, incidence of health problems and milk production. Two blood samples were collected from each cow at 14 to 21 days (sample 1) and 38 to 45 days (sample 2) postpartum. Blood samples were analyzed for packed cell volume, hemoglobin, total protein, calcium, phosphorus, magnesium, copper, zinc, and selenium concentrations. A number of significant relationships were found between blood components and the various measures of performance. However, the importance of these relationships is uncertain because the variation was great. Additional work is needed to determine the value of using blood composition in diagnosing problems detrimental to cow health and performance.

Cow-Side Progesterone Assay: (Larry L. Larson)

A study has been started to try to develop a simple cow-side test for progesterone levels in milk. A simple test for milk progesterone would make it possible to determine immediately if a suspected cow is actually in heat. In addition, it could be used as an early, on the farm, test for pregnancy.

Re-establishment of the Reproductive Cycle in Cows After Calving: (Larry L. Larson)

The time interval from freshening until the cow starts cycling greatly influences the time required in getting a cow re-bred. The value of hormone and vitamin treatments on reducing this interval is being examined.

Group Feeding: (Foster G. Owen and Larry L. Larson)

Two group feeding trials to evaluate methods for providing supplemental grain to selected cows in group feeding systems and to compare methods of cow assignment have been completed. Trial 1 cows were in one group and selected cows were allowed additional grain from a magnetic feeder. Cows were randomly assigned to one of the following treatment groups: 1) Basal Ration of a complete blended ration fed continuously throughout lactation, 2) Basal Ration plus access to the magnetic feeder until 16 weeks post-partum for all cows, or 3) Basal Ration plus access to the magnetic feeder as long as they were producing more than 55 lb. (25 kg) per day (45 lb., 20 kg for heifers). Trial 2 cows were shifted between the "Basal" and "High" lots according to one of the following three assigned treatment schedules: 1) Basal Ration for the entire lactation as for trial 1, 2) a High Energy Ration fed to all cows to 16 weeks post-partum then shifted to the Basal Ration group, or 3) cows assigned to the High Energy Ration when producing 55 lb. (25 kg) milk or more per day (45 lb., 20 kg for heifers) and then shifted to the Basal Ration when producing below these levels. Data collected included: daily milk production, monthly body weights and health and reproductive performance. Analysis of the data has not been completed.

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