1979


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Issued August 1979, 3,600

Extension work in “Agriculture, Home Economics and subjects relating thereto,” The Cooperative Extension Service, Institute of Agriculture and Natural Resources, University of Nebraska–Lincoln, Cooperating with the Counties and the U.S. Department of Agriculture
Leo E. Lucas, Director

The Agricultural Experiment Station
Institute of Agriculture and Natural Resources
University of Nebraska–Lincoln
H. W. Ottosen, Director
Nebraska's Dairy Industry Future

Irv Omtvedt
Head
Department of Animal Science

Although Nebraska's dairy cow population has been declining since 1984, 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 sparsity 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.

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 dairy programs.

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

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. Improved 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 DHI program in 1977-78 averaged 13,178 (5,978 kg) milk compared to the state average of 10,200 lb (4,027 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 DHI average, Nebraska dairy farmers could gross an additional $235 million annually if the herd would take 28,474 fewer cows (22.0%) to produce the 1978 total milk production.

5. Herd breeding efficiency will be improved. Current research emphasis on heat detection and re-breeding 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 Universities 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 capital 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 1. Nebraska grain and forage production in 1977.

<table>
<thead>
<tr>
<th>Grain</th>
<th>Production (bu)*</th>
<th>Sorghum grain</th>
<th>Corn</th>
<th>Winter wheat</th>
<th>Oats</th>
<th>Soybeans</th>
<th>Beans</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1,000 bushels)</td>
<td>151,250</td>
<td>629,650</td>
<td>103,250</td>
<td>58,860</td>
<td>1,550</td>
<td></td>
</tr>
</tbody>
</table>

Table 2. Dairy cows trends in Nebraska.

<table>
<thead>
<tr>
<th></th>
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<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>280,000</td>
<td>29,100</td>
<td>9.6</td>
<td>6,600</td>
<td>2,994</td>
<td>5,000</td>
<td>5,554</td>
<td>10,200</td>
<td>11,000</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Name</th>
<th>Program distribution, %</th>
<th>Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mike Turner</td>
<td>50% Dairy Marketing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>35% Dairy Housing</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15% Dairy Management, Youth Programs, Supervisor of Dairy Publications</td>
<td></td>
</tr>
<tr>
<td></td>
<td>15% Dairy Production Instructor</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Dairy Nutrition, Instructor for Computer Feeds &amp; Dairy</td>
<td></td>
</tr>
<tr>
<td></td>
<td>10% Dairy Management, Youth Programs, Supervisor of Dairy Publications</td>
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<td></td>
</tr>
</tbody>
</table>

Table 4. Dairy herd management system.

<table>
<thead>
<tr>
<th>Manure Management</th>
</tr>
</thead>
</table>

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, an intermediate processing option, such as methane production, drying, composting, or liquid/solid separation, may be an intermediate processing option, such as methane production, drying, composting, or liquid/solid 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 market outlet.

Daily Hauling

For many dairymen, daily hauling is still the preferred and more satisfactory system. Daily hauling does have disadvantages which lead producers to consider other management strategies. When compared with a storage system, daily hauling requires more time and labor to maintain the storage facility and the land application site. In addition, daily hauling often requires a more sophisticated system for handling and transporting manure. Daily hauling is also subject to governmental regulations and restrictions, which can limit its use in certain areas.

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Manure Management
(Continued from page 3)

hunting 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 availability, and surface application leads to a high potential for pollution due to run-off.

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. Storage 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, earthbank, slot 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 the storage, and land application equipment. The location of storages relative to grade is important due to 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 top front-end loader and conventional boxes.

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 bins. However, it will not flow rapidly enough for efficient pumping. The sprayer might be either a box sprayer with a hydraulic tailgate or an open tank-type unit.

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

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 capacity (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 number 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 rut may increase surface runoff and cause farmland problems.

Manure 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 in storage equipment for land application of $8,000-10,000. Current prices for earthbank storage are about 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 rail for all openings.

4. Provide a substantial wall or fence around the 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 among cattle or personnel during agitation and pumping operations. Discontinue these operations and ventilate the 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 “Live­ stock and 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.

<table>
<thead>
<tr>
<th>Table 1. Characteristics of commonly used manure management systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manure handling consistency:</td>
</tr>
<tr>
<td>Slurry</td>
</tr>
<tr>
<td>Liquid</td>
</tr>
<tr>
<td>Storage construction cost:</td>
</tr>
<tr>
<td>Storage land area requirements:</td>
</tr>
<tr>
<td>Storage loading options:</td>
</tr>
<tr>
<td>Conveyor</td>
</tr>
<tr>
<td>Pump (tub or large piston)</td>
</tr>
<tr>
<td>Storage unloading options:</td>
</tr>
<tr>
<td>Gravity</td>
</tr>
<tr>
<td>Pump</td>
</tr>
<tr>
<td>Agitation required before storage unloading</td>
</tr>
<tr>
<td>System places limitations on types or coarseness of bedding</td>
</tr>
<tr>
<td>Spreader type (B=low, T=tank)</td>
</tr>
<tr>
<td>Is additional system or equipment required for management of milking center effluent, lot runoff, or precipitation?</td>
</tr>
<tr>
<td>Odor potential from storage unloading and land application</td>
</tr>
<tr>
<td>Work load distributed throughout year</td>
</tr>
<tr>
<td>Is heating of precipitation required?</td>
</tr>
<tr>
<td>Easily expanded to accommodate larger herd</td>
</tr>
<tr>
<td>Use limited by shallow beds or high water table level</td>
</tr>
<tr>
<td>Daily labor requirements</td>
</tr>
</tbody>
</table>

- 1.00 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.
Each year are born from first-calf heifers. This is assuming that the average age of milking cows is about 14 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 the replacement heifers carrying 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 a 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 that have a greater potential for higher production. Of course, some of these heifers will produce less than the best females heifer one would like to use in a replacement heifer program. Therefore there is a need to use artificial insemination of heifers to improve the average production level of heifers.

Three in a Lifetime

The average age of cows in Nebraska dairy herds is less than five years. So, on the average, any heifer 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 x 0.5 x 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 sire 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 PTD'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 (PDI's) above +800 lb (363 kg) of milk. This means that in the average herd of dairy cows the daughters of such sires 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 offspring. In other words, using AI bulls with PDI'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 PTD's for milk production also have high + PDI's for predicted differences for type. Improvement in type is part of the dairyman's goal, semen from such bulls can be purchased at reasonable prices.

It is likely recognized that the frequency of calving problems is higher in heifers than in cows. Therefore any program that is more effective at reducing these problems will be of greater potential to the dairy producer. A dairyman to breed heifers to sires which produce smaller calves to reduce these problems. The current interest of dairymen in the quality calf sire 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 herd. 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 these bulls suffer from fewer calving difficulties. The consequences of this policy frequently are unforeseen.

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 enter the milking herd. So, for every 10 milking cows, there will be only 8 heifers to replace them. This leaves no possibility of selection on the basis of production. The average dairyman must keep milking cows in his herd to an older age just to maintain his present herd size. Furthermore, if he bred his cows by AI to sires with PDI's of +800 lb (363 kg) of milk or more these heifers are the best group of potential dams of more replacements. Heifers sired by non-dairy bulls eliminate the possibility of utilizing this higher transmission 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 PDI, which also has been bred 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. However, any sire 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 return can easily 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 sire bull should be used. Its sire and maternal grandsire should both have plus PDI'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 high production, then 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 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. The most important, recognize the loss of potential production of the herd which results from losing one-third of the heifer calves per year, from the replacement heifers, and make a 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

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 aids 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) mounting detector, 3) chalk on tailhead and 4) testing a dairyman treated cow fitted with a chin-ball marking device. Changes in proestrus levels in the milk.
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 detection and elevated seven days later or if the cow was bred and conceived, a true heat was considered. 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, the most efficient in detecting cows in heat were the visual observation of activity, the activity of testosterone treated animals was 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 mounting. It should be emphasized that only the cows actually observed standing to be mounted were included in this study. Also, these cows were confined to a concrete lot which at times was icy and slippery and the cows had not been handled. These conditions inhibit mounting activity. Other researchers estimate that about 50% of the heat cycles in a dairy herd 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 calves 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.

<table>
<thead>
<tr>
<th>Calf Raising: Let’s</th>
<th>Keep It Simple</th>
</tr>
</thead>
<tbody>
<tr>
<td>Foster G. Owen Professor, Dairy Nutrition</td>
<td>reducing the labor required for feeding compared to conventional systems</td>
</tr>
<tr>
<td>Larry L. Larson Associate Professor, Dairy Physiology</td>
<td>for calves at 42 days of age. However, gains on both</td>
</tr>
<tr>
<td>Calf raising represents a long term investment of feed, labor, and other costs and 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.</td>
<td></td>
</tr>
<tr>
<td>Since 1963 we have been experimenting with calf raising programs. One objective 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 not equally good when milk or colostrum was fed at a warm (32 to 35°C) temperature. In other experiments we learned that calves could be successfully weaned at 3 weeks of age.</td>
<td></td>
</tr>
<tr>
<td>Early weaned calves need a palatable starter ration and fresh water available continuously.</td>
<td></td>
</tr>
</tbody>
</table>

**Table 1. Growth data.**

<table>
<thead>
<tr>
<th>Plan</th>
<th>Weight at 64 clays (lbs)</th>
<th>Height at 64 clays (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Nebraska Plan</td>
<td>134 (60.8)</td>
<td>30.6 (77.6)</td>
</tr>
<tr>
<td>Nebraska Plan</td>
<td>134 (60.8)</td>
<td>30.6 (77.6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Plan</th>
<th>Weight at 64 clays (lbs)</th>
<th>Height at 64 clays (in.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard Nebraska Plan</td>
<td>134 (60.8)</td>
<td>30.6 (77.6)</td>
</tr>
<tr>
<td>Nebraska Plan</td>
<td>134 (60.8)</td>
<td>30.6 (77.6)</td>
</tr>
</tbody>
</table>

**Table 2. Reproduction and milk yields.**

| Nebraska Standard Plan | Services/ conception to first service | Conception to second service | Days open | Days in milk | Milk yield
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1.44</td>
<td>1.48</td>
<td>61</td>
<td>62</td>
<td>289</td>
<td>508</td>
</tr>
</tbody>
</table>

**Efficiency of reproductive and milk performance.**

Data in Table 1 show that calves on the Standard Plan gained more weight than calves on the Nebraska Plan. This difference, also seen in weights at 56 days, is probably due to a 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.

By 6 months of age, gains were practically equal for the two groups and remained similar at 12 and 18 months of age. Therefore, gains were slightly higher for the Nebraska Plan calves. At calving time they averaged 20 lb (9 kg) heavier, but wither heights were identical. None of the growth measurements 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 95% 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 other factors.

Milk production data (Table 2) were converted to mature equivalent.

**Table 2. Reproduction and milk yields.**

<table>
<thead>
<tr>
<th>Nebraska Standard Plan</th>
<th>Services/ conception to first service</th>
<th>Conception to second service</th>
<th>Days open</th>
<th>Days in milk</th>
<th>Milk yield</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.44</td>
<td>1.48</td>
<td>61</td>
<td>62</td>
<td>289</td>
<td>508</td>
</tr>
</tbody>
</table>

**Conclusions**

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, reproductive and first lactation yields were equal to that for calves fed normal milk by the conventional twice a day feeding plan. One day out of every two years from pneumonia before calving, two after calving, one after an injured back and one had dead twins and never recovered normally.

The losses on both plans were similar, so detrimental effects on health could be related to the restricted plan. 

**Effects on Growth**

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

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 near 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 stages of the reproductive cycle (Figures 1 and 2). The concentration of progesterone in milk was highest 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 ovulation, it is not a practical method for identifying cows in heat. This is because the level of progesterone in milk takes too long to be 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 day, are minimal from one day before to two days after heat and are higher during the remainder of the cycle and during pregnancy. A simple cow-side test is needed to make its use feasible in dairy cows. No other milk component has been proven to be a dependable indicator of heat. However, sodium seems to have potential and needs additional study.

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.

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 tailored 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 for 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 ($5.10/100 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 $2.69/cwt ($5.72/100 kg) on an "as fed" basis, or a savings of 36¢/cwt.

- 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 ($5.10/100 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:

<table>
<thead>
<tr>
<th>Protein Value</th>
<th>Cost/cwt (as fed)</th>
</tr>
</thead>
<tbody>
<tr>
<td>16% protein</td>
<td>$2.69/cwt</td>
</tr>
<tr>
<td>13% protein</td>
<td>$3.21/cwt</td>
</tr>
</tbody>
</table>

This leaves a cost of 12¢ 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 protein is deficient by 1.5 percentage units.

One can approximate the decrease in milk production by utilizing this formula: 15 protein deficiency x 1.5 lb (.68 kg) milk x 12¢/lb (24¢/kg) milk = $0.18/cow/day. In this case we would have 25¢/cwt/day loss in decreased production. By paying 12¢ to reformulate you save 15¢/cwt/day, $300/month or $4,000/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 dairy cow production.

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

<table>
<thead>
<tr>
<th>Protein Value</th>
<th>Cost/cwt (as fed)</th>
</tr>
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<tbody>
<tr>
<td>16% protein</td>
<td>$2.69/cwt</td>
</tr>
<tr>
<td>13% protein</td>
<td>$3.21/cwt</td>
</tr>
</tbody>
</table>

Alfalfa hay mid-bloom (corn-soy - minerals)
16% (average) Base $2.76/cwt
20% Base $2.96/cwt
25% Base $3.21/cwt
13% (heat damaged) Base $3.00 $3.00 $3.00

These results were not adjusted for heat damage.

Quality Protein For the High Producer

Dr. Mary L. 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.

(Continued on next page)
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 ration 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 now know that it is necessary to increase the amount of true protein that reaches the small intestine and rumen. A protein that should have an amino acid make-up patterned to the requirements of the cow is one that will escape degradation in the rumen. Table 1 and 2 show the effect of various levels of soluble nitrogen on milk production and fiber digestion in lactating cows. Excessive levels of soluble nitrogen are extracted 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 requirement. This means that the high producing cow requires even more of the coarsely degradable protein that will escape breakdown in the rumen.

Several experiments have demonstrated that low 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 2.8 lb per day (1.4 kg). This indicated that additional high quality, non-degradable protein is actually needed by the high ability cow.

### 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 North-West 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 breakdown in the rumen and caused the increase in milk production.

It would be economically beneficial to formulate protein supplements using areas to provide soluble nitrogen in the rumen in combination with protein sources that are more 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 various levels of less degradable protein sources and urea provided greater growth response. In combination with the 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 protein sources such as urea be included to provide adequate N2H4-nitrogen for maximum microbial synthesis and fiber digestion.

Much of the research concerning the inclusion of 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 a smaller amount 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 needed for milk production. 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 be achieved 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 increased milk 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 be given to the inclusion of low bypass sources of protein which resist breakdown in the rumen and to the amino acid content of these proteins.

### Computerized Rations Pay Off

**Foster Owen**  
Professor, Dairy Nutrition  
Scott Hadden  
Extension Assistant

The AGNET FeEDmix program for dairy rations provides several excellent opportunities 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. This is used to determine whether a particular ration currently being used by a dairymen is satisfactory. The computer will evaluate the ration by comparing its nutritional requirements, 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 dairymen’s ration contains 1.25 lb (5.5 kg) per 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 (.05¢ per kilogram) for milk, the dairymen 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 15¢ per cow or $2.372 annually for a 30-cow herd.

Example 2: This ration is short on energy by an amount of 5 Mcal of estimated net energy (ENE) per calf day (5.4 kg). In other respects the ration is adequate. What amount of loss does this cause?

For cows of high ability, this 5 Mcal of ENE could amount to about 10 lb (4.5 kg) daily loss in milk yield. If milk price is 11¢ per pound (.05¢ 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 protein deficiency. Many rations we have checked are deficient in several factors, while others are deficient in one or two. Either of these situations may reduce net income of the herd.

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

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

<table>
<thead>
<tr>
<th>Protein source</th>
<th>Soluble nitrogen</th>
<th>Moisture (25%)</th>
<th>% of ration</th>
<th>Daily milk production (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean meal</td>
<td>6.5</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Blood meal</td>
<td>6.0</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Meat meal</td>
<td>6.0</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Corn gluten meal</td>
<td>6.0</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Distillers grain</td>
<td>6.0</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Dehydrated alfalfa</td>
<td>6.0</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
</tbody>
</table>

*Significantly greater than other treatments (P<.05).*

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

<table>
<thead>
<tr>
<th>Protein source</th>
<th>Rumen ammonia (kg)</th>
<th>Dry matter (25%)</th>
<th>% of ration</th>
<th>Daily milk production (lb)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean meal</td>
<td>8.6</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>11.5</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>15.2</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>18.0</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>21.7</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>25.3</td>
<td>16.0</td>
<td>38.6</td>
<td>23.0</td>
</tr>
</tbody>
</table>

**Conclusion:** In feeding the high producing cow, ideally more than 15% protein is needed in the diet to support milk production.

**Example 1:** The AGNET program can provide dairymen with a CHECK-UP to evaluate the nutritional adequacy of their present feeding programs.

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

<table>
<thead>
<tr>
<th>Protein source</th>
<th>Feeding value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Soybean meal</td>
<td>100</td>
</tr>
<tr>
<td>Blood meal</td>
<td>200</td>
</tr>
<tr>
<td>Meat meal</td>
<td>185</td>
</tr>
<tr>
<td>Corn gluten meal</td>
<td>200</td>
</tr>
<tr>
<td>Distillers grain</td>
<td>173</td>
</tr>
<tr>
<td>Dehydrated alfalfa</td>
<td>190</td>
</tr>
</tbody>
</table>

*Best values with a high quality protein.*
some other problems which can be detected with this procedure are:

1. Inadequate fiber, coarse roughage, and hay equivalent
2. Calcium-deficient 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 some time 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 by various symptoms which exist. Again, the value of correcting such problems cannot be overestimated. 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 better feed efficiency.

5. Undesirable feedstuffs. If the ration has one or more feeds which the computer will usually find these and indicate whether the level included is likely to be a problem. The RATION CHECK program will help diagnose possible problems with a particular ration.

There is a problem or deficiency in the ration, what can be done? 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 program the dairymen will learn whether their present ration is sound. If it needs adjustment, he will know 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 plan involving all the nutrients and quality specifications required for a sound, top quality ration at the lowest cost. The program is useful to dairymen in:

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 the cost of certain other ingredients. Selecting grains. The potential savings in selecting certain 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 included.

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

<table>
<thead>
<tr>
<th></th>
<th>December 1976</th>
<th>December 1977</th>
<th>November 1978</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grain</td>
<td>Ration</td>
<td>Ration</td>
<td>Ration</td>
</tr>
<tr>
<td></td>
<td>Corn</td>
<td>Oats</td>
<td>Wheat</td>
</tr>
<tr>
<td>Corn</td>
<td>72.4</td>
<td>72.4</td>
<td>67.4</td>
</tr>
<tr>
<td>Oats</td>
<td>21.0</td>
<td>21.0</td>
<td>16.7</td>
</tr>
<tr>
<td>Wheat</td>
<td>17.6</td>
<td>17.6</td>
<td>16.1</td>
</tr>
<tr>
<td>Soybean meal</td>
<td>21.0</td>
<td>21.0</td>
<td>17.5</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>21.0</td>
<td>21.0</td>
<td>17.5</td>
</tr>
<tr>
<td>Cottonseed meal</td>
<td>21.0</td>
<td>21.0</td>
<td>17.5</td>
</tr>
<tr>
<td>Malt</td>
<td>72.4</td>
<td>72.4</td>
<td>67.4</td>
</tr>
<tr>
<td>Limestone</td>
<td>97.8</td>
<td>97.8</td>
<td>97.8</td>
</tr>
<tr>
<td>Dicalcium phosphate</td>
<td>3.73</td>
<td>3.73</td>
<td>3.73</td>
</tr>
<tr>
<td>TNM</td>
<td>120</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Vitamin A supplement</td>
<td>28.0</td>
<td>28.0</td>
<td>28.0</td>
</tr>
<tr>
<td>Soy/cotton (45 kg)</td>
<td>$6.85</td>
<td>$5.25</td>
<td>$5.24</td>
</tr>
<tr>
<td>Savings with least-</td>
<td>$4.58</td>
<td>$2.98</td>
<td>$2.96</td>
</tr>
</tbody>
</table>

Feeder 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 affect the digestibility or performance of another forage.

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 to 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.

Forage Calculations. 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 being perishable, the use of the computer is the only way to do a complete feeding job.

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 feed program:

1. High Quality Roughage. This proven to be the most important element of any successful dairy feeding program. Alfalfa hay and corn silage are the primary roughages and alfalfa hay is selected. 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 hay 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. In addition to roughing or storing situations unique to a particular operation other forms of common feeds, such as barley and sorghum, are utilized. These include whole soybeans, high-moisture corn, high-moisture wheat, and canola seed.

3. Other Feeds. Feeds which are by-products of production in your area, can sometimes be purchased at a lower price and may be advantageous to your advantage. Of a long list, a few might be hominy feed, brewers grains—wet or dry, beet pulp, cottonseed hulls, wheat—wet or dry, barley, wheat midds and soy hulls.

4. Added Fiber. Some dairymen have done such a good job of producing high quality hays, 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, beet pulp, brewers grains, corn cobs, separated animal waste, corn stalks, or even cardboard. A high quality, balanced and blended properly 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 platform. This last method involves counting dumps which are periodically checked by weighing a known weight of feed. 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, wastage, or other. 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 feeding every cow at 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 is hot to feed it.

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. Feeds available to cows has changed considerably in the last few years. From the usual grain feeding containing high alfalfa. Don’t forget concentrates, purchases, bookkeeping 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 platform. This last method involves counting dumps which are periodically checked by weighing a known weight of feed. 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.

Some other practices recommended to improve palatability and intake when parlor feeding include: pelleting, adding fat or molasses, using high moisture grain, and providing outside self-feeders for some or all cows. The use of self-feeders which allow individual cows to feed in 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 transponder is fed for every time a cow so that she can be given exactly the grain desired. Some other devices which fit these criteria are: artificially increasing the hours of light, multiple feedings, locating feed bunk to cleaning bunk banks, often feeding only fresh feed, providing shade, and mechanical feeders.

Perhaps the biggest change from conventional feeding is the total reliance on machines in which 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, dicing and handling cows as groups becomes important. The most important consideration is to get the dry cows separated from the milking herd. Any groupings of the herd three or four production lots are recommended, with cows housed in parallel lots in the milking barn to avoid stress during the total ration feeding.

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**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 came into effect in 1980, neither Grade A nor manufacturing milk producers could market their milk when they violate the somatic cell standard.

Because the Somatic cell count is so wide spread 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 teats. Occasionally, these bacteria enter the udder through the teat canal. Once inside, these pathogens multiply rapidly on the lining of the teat, eventually entering the udder 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 leukocytes (a type of somatic cell) into the infected area. When the leukocytes encounter bacteria, they engulf and destroy them.

Leukocytes flood the site of the infection until most of the infecting organism is destroyed. Usually, high leukocyte 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 leukocytes (white blood cells) and epithelial cells sloughed from secretory tissue. During mastitis, most of the leukocytes present in the milk are polymorphonuclear (PMN) leukocytes formed in the bone marrow and released into 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 diet-manure teat 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. 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, and the milking machines, contact with common objects in the environment.

2. **Unsanitary tools that are covered with milk and mud or maneuver 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.

3. **Improperly cleaned or maintained milking equipment also provides an environment in which pathogenic bacteria can grow and multiply contaminating all of the milk that comes in contact with it.**

4. **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.

5. **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.**

6. **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 cow. Remove objects from the barn which could injure the udder.

2. Wash hands with sanitizing soap and water before reaching for teats during milking. Avoid contact with the udder when the hand is infected. If necessary, wear disposable rubber gloves.

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

4. Milk freshly cleaned and sanitized milking equipment.

5. Maintain milking equipment, i.e., check vacuum levels, teat cups, and cervices. 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) over milking.

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-triazine are effective in controlling the most common types of mastitis-causing bacteria. Also, the use of teat dips one week after a teat culture test will be required after seven days of initial treatment. For dairymen who do not keep records of cell counts on individual cows, the administration of antibiotics to all quarters of all teats is recommended. In general, the combined use of teat dips and dry treatment over a three year period reduces infection rates by 75%.


10. Provide proper care for chronic incurable cases of mastitis.

**Regulations and Somatic Cells**

The Nebraska Manufacturing Milk Act of 1969 states the following: "1. A milk producer producing for manufacturing milk for somatic cells: "A Wisconsin Mastitis Test (WMT) or a WMT-tolerant test approved by the Department shall be conducted on a sample of herd milk to determine if a producer is honestly producing milk in accordance with this rule." Table 3 presents data on the application of individual WMT tests, after implementation of a mastitis prevention program.

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

<table>
<thead>
<tr>
<th>Mastitis Count</th>
<th>Milk Color</th>
<th>Milk %</th>
<th>Milk %</th>
<th>Milk %</th>
<th>Milk %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Under 150,000 (0%)</td>
<td>32.1</td>
<td>34.9</td>
<td>46.3</td>
<td>41.9</td>
<td>41.0</td>
</tr>
<tr>
<td>150,000-299,999 (0%)</td>
<td>15.7</td>
<td>21.2</td>
<td>21.2</td>
<td>19.4</td>
<td>21.2</td>
</tr>
<tr>
<td>300,000-499,999 (0%)</td>
<td>15.7</td>
<td>19.4</td>
<td>19.4</td>
<td>15.7</td>
<td>19.4</td>
</tr>
<tr>
<td>500,000-999,999 (0%)</td>
<td>15.7</td>
<td>19.4</td>
<td>19.4</td>
<td>15.7</td>
<td>19.4</td>
</tr>
<tr>
<td>Over 1,000,000 (0%)</td>
<td>15.7</td>
<td>19.4</td>
<td>19.4</td>
<td>15.7</td>
<td>19.4</td>
</tr>
</tbody>
</table>

| Herd average | 0.000 | 1,689 | 475 | 461 |
| Quality index | 8 | 19 | 9 | 5 |

**How to Cure Existing Infections**

1. **Dry cows with treatment.** Bacteria is 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 teats is recommended. In general, the combined use of teat dips and dry treatment over a three year period reduces infection rates by 75%.

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

3. Provide proper care for chronic incurable cases of mastitis.

**Funding and Cost**

Today's DAH records provide the dairymen with specific information about his herd's feeding program. For example, the concentrate (grain mixture) needed for each individual quarter is determined based on the cow's age, her gestation period, and daily requirements. In essence, the cost of feeding is determined by the decrease in cost of feeding. 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. If a producer of Grade A milk could not have his certificate to sell milk suspended if he produced abnormal milk, the producer of Grade B milk would not be allowed to market their 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. If a producer of Grade B milk is suspended for producing abnormal milk, he will lose his license to sell milk. In the future, the producer of Grade B milk will not be able to sell his milk.
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 Maternal Equivalent (predicted potential) and a HerdMate Comparison. The Maternal 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 his 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 individual comparison it is a critical one and also a fair one. With these two comparisons available for the next 12 months, 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 great 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 the highest 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. On this his measure of the effectiveness of his culling program is also provided.

Reproduction

On a monthly basis the dairyman should receive returns of information about each cow: (1) days dry, (2) due date and (3) a pregnancy record. Here 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 Regro Program. This program provides the dairyman with a very detailed analysis of his entire herd.

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. Lactation animals that are not equal or superior to later lactation animals in this signal is a message 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 calve 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 forage 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 remembers that his first lactation animals have an equal opportunity to produce and is sure that he has done the best he can do to improve his herd he will need to consider seriously culling them more closely, and review his sire selection policies.

Calf Hutches

"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. But 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 is also the least expensive housing system for calves now in use.

In this article we will look at evidence for success of herd 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 or more of the calves born is not uncommon on many farms. However, death losses reported on calves raised in hutches generally

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

<table>
<thead>
<tr>
<th>Item</th>
<th>Per Cow</th>
<th>Per Herd</th>
<th>Sample Day</th>
<th>365 Days</th>
<th>365 Days</th>
<th>365 Days</th>
</tr>
</thead>
<tbody>
<tr>
<td>Forage cost</td>
<td>.34</td>
<td>.288</td>
<td>19</td>
<td>9210</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Grain cost</td>
<td>.34</td>
<td>.271</td>
<td>24</td>
<td>8667</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total feed cost</td>
<td>.34</td>
<td>.559</td>
<td>47</td>
<td>17877</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Value of production</td>
<td>5.69</td>
<td>1421</td>
<td>129</td>
<td>4347</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Income over feed cost</td>
<td>2.72</td>
<td>1421</td>
<td>92</td>
<td>27297</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feed cost per cwt.</td>
<td>.30</td>
<td>5.80</td>
<td>5.61</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Return per $1 feed cost</td>
<td>2.76</td>
<td>2.54</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk price per cwt.</td>
<td>2.91</td>
<td>9.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
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 hutch. They lost only 8.5% of these calves. About half their losses were during the first week. A sudden drop in temperature of 15° to 20°F (-9°C to -7°C) or more was associated with about 50% of the losses. They found best weight gains were made between 30° and 60°F (1° to 15°C). Even at 0° to 10°F (-18° to -12°C) gains were .5 lb/day (.7 lb/d) during the period from birth to four weeks of age. This is well above the .25 kg/day (5 lb) that is 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 were no differences in milk production. In our research at Mead we have used outside hutch since 1977. During this period we have lost 4 of 10 calves born. Before this we used the inside hutches mainly between April and November. During a major experiment during this period we lost only 1 of 48 calves started. These diseases which are common for young calves in cold, and indoor, housed, 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. Hoard Dairyman published a story of four such herds involving 553 calves. In hutches they raised 316 or 95% of these calves. Included were Brown Swiss, Guernsey, and Holstein herds located in Minnesota, Wisconsin, Massachusetts, and Georgia.

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

1. 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.

2. Less bedding and cleaning. Less bedding and feeding is required 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.

3. Get the calf into the hutch as soon as its has had its first colostrum. During the first day calves should either be outside with their dam or in a cold type (unheated) building.

4. Flexible. Hutches can 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.

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

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

**DAIRY**

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